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Editor

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A Harbinger of Peace— The World Power Conference

IF WE pause but a moment to consider, we must realize the place that power holds in the future of our civilization. The industrialism upon which modern nations depend for their very life could never have been developed if means had not been found for supplementing the efforts of man's hands with the work of machines. If development is to continue along such lines and a life of comfort and well-being is to be possible for the ever-increasing millions of the world's population, intelligent co-operation must obtain among the nations in the development and utilization of their power resources.

During the first part of July nearly four hundred and fifty engineers, scientists and economists gathered at the great British Empire Exposition at Wembley for the first World Power Conference. The conference was somewhat ambiguously named, for the term world power has become associated with dominant nations, whereas the conference, of course, had to do with mechanical power in its technical, financial and economic aspects.

Thirty-nine nations were represented at the conference and discussed power development in all its phases with entire candor unhampered by any political considerations. More than four hundred papers were presented averaging about 8,000 words each. The facts concerning the resources, generation and uses of power in each of these nations were placed on the table for the benefit of all. The supplies of various fuels and the possibilities of hydro-electric development throughout the entire world were detailed. Experience and practice in the generation and use of steam and electricity were compared. Methods for the preparation and combustion of fuels—solid, liquid and gaseous—were discussed. Modern methods in power transmission and distribution were reviewed. Much information was given on the varying uses of power in industry, transportation, agriculture and the home. And finally, the economic, financial, educational and legal aspects of the power problem were developed.

From the technical standpoint there was little that was novel. Such was not the primary purpose of the conference. It served, however, to marshal facts on the state of development of power in every important industrial nation and to assemble them in one place for the benefit of the world at large. The published report of the conference will serve as a monumental compendium —a reference library of authoritative information for the technical men of every country.

Valuable as is this phase of the conference, it is by no means the most important. There was everywhere the spirit of generous, willing co-operation on the part of the delegates. That spirit borne home by the delegates will be disseminated and will act as a powerful leaven toward the increase in international fellowship. The benefits from this are inestimable. The realization by the technical men of any nation that the engineers of all other nations are eager to co-operate in the better utilization of the world's resources of power and fuel can not fail to have a salutary, progressive and pacific influence.

The able address of the much beloved Prince of Wales in welcoming the delegates developed another point of prime importance. "You are at grips with fundamentals," he said, "and from your deliberations will result the first enunciation of a policy applied internationally which may contribute largely to the harmony and economic progress of the world. International co-operation may emerge from the realm of the ideal into the realm of practical utilization as the result of your deliberations and I sincerely trust that full success will attend them." Not only technical benefit and a friendly spirit have resulted but a beginning of international policy with its basis on the solid substance of engineering fact. Technical men can appreciate what it will mean to the world to have a co-operation that leaves no room for controversy or for the prejudices and passions that have dominated international relations since before the dawn of history. It is the beginning of a new era dominated by intelligence and reason. It cannot come in a moment, but it is sure to come and the World Power Conference is a significant gesture.

Technical Hospitality

AS HOST to the American Institute of Chemical Engineers, 2 weeks ago Denver lived up to its finest traditions for unfeigned hospitality; and the guests that journeyed there from the East to hold their regular summer meeting were well rewarded for their efforts.

The West has no finer heritage than the spirit of the pioneers who, only a short 65 years ago, were drawn to Colorado by the discovery of gold. Over the same route along which the members of the Institute rolled in the elegant luxury of Pullman cars from Omaha to Denver, the hardy adventurers of an earlier generation made their toilsome way with ox teams before the advent of the railroad or even the stage coach. The common perils and hardships of that day led to a community of interest and bred a spirit of interdependence and generosity in which the individual was subordinated to the group. Whatever was best for the latter was good for the former.

The latchstring which literally hung out in those days does so figuratively today; and the personal hospitality of that time influenced and determined the free exchange of technical information that later characterized Western metallurgical development. There are no more striking examples of the utility of free technical intercourse than the perfection of the cyanide process of ore treatment and the evolution of copper

metallurgy, both of which reached their highest state of development in the West. The welfare of the industry was paramount to private interest, for the individual unit prospered in proportion to the growth of the whole. The smug cloak of secrecy, where it chanced to exist, served mainly to hide the rags of poverty of knowledge and antiquated methods.

It was therefore typical of the program at Denver that the technical staff of the Great Western Sugar Co. should offer a wealth of information on the beet-sugar industry, thus perpetuating the best traditions of an earlier day by extending technical hospitality in generous measure. The company's pre-eminent position may be ascribed largely to the organization and maintenance of a research and technical staff that has raised beet-sugar production to a high position among the chemical engineering industries. The instance stands as a fine example to other industries, notably in the East, where the spirit of technical hospitality has not yet been recognized and fostered.

Science Militant— An Exposure of Cults

TRUE educational endeavor involves the exposure of the misleading and the specious as well as the dissemination of scientific fact. To be critical is the more difficult task, usually evaded because of a common dislike to disturb deep-seated opinions held by well-meaning individuals, whose belief in what is opposed to the discoveries and teachings of science springs from an acquired faith. Such faith may be defined, as the schoolboy expressed it, as "the quality that enables you to believe what you know to be untrue."

To embrace all the branches of systematized ignorance, Dr. David Starr Jordan coined the word "sciosophy," or "shadow wisdom." And those who attended the recent meeting of the Pacific Coast Division of the American Association for the Advancement of Science, at Stanford University, had the opportunity of hearing a remarkable address on the subject from that distinguished scholar and philosopher—remarkable in its impassioned delivery, as well as in the uncompromising attitude of denunciation that characterized it.

Sciosophy, we learned, differs from science, which is derived from tested and verified human experience. Sciosophists do not rely on the relation between cause and effect; they need no instruments of precision, mental or physical; their creed is based on principles —so called. The soundness of their arguments is proved by inversion. As the founder of what Dr. Jordan calls Neminism argued: "There is no pain in truth; therefore there is no truth in pain. There is no nerve in mind; therefore there is no mind in nerve. There is no matter in good; therefore there is no good in matter."

The slow and painstaking investigation familiar to scientists is scorned by the sciosophist, whose methods are rapid and unhampered by argument or fact. The temptation to advance toward the infinite by quick methods is very great. Thus in disposing of the subject of evolution a decision from South Carolina read as follows: "*Resolved*, that man was created by an instantaneous process without previous animal parentage." As a deduction, nothing could be simpler. Similarly, a Texas cult "reaffirms its historic stand that Adam's body was fashioned out of matter previously created out of nothing." Proof is obtained by inversion: There is no man in animal; therefore there is no animal in man!

Humanity demands authority—a pillar to lean against; and sympathy—a bosom on which to weep, said Dr. Jordan. "Esoteric dreams solace the future; absent treatment is better than present medicine." A high priest of the Neministic cult advises one to "treat a belief in sickness as you would sin—with sudden dismissal," adding, "The equipollence of the stars above and the mind below shows the awful unreality of evil." The followers of esoteric doctrines such as this segregate into cults—the outcome of the teaching of sciosophy. Science, on the other hand, has no divisions, no cults. It is classified knowledge—human experience, tested and verified by mechanical instruments of precision and by the mental instruments of memory, logic and mathematics. Science is our estimation of realities; it is common sense, expanded and verified and applied to a wide range of objects. It has three great purposes: To help humanity; to furnish a sound basis for the conduct of life; to widen the human mind. "Liveableness"—or the degree to which we might trust our lives to it—is the final test of truth.

The Passing of "Pittsburgh Plus"

IN ALMOST every American town there is, according to Don Marquis, a "Jake Smith's place," a roadhouse or restaurant that enjoys a shady reputation. Yet it is a landmark and when it is burned or torn down the passing of even this disreputable landmark brings a feeling of emptiness.

Perhaps this will best describe the first feeling of the average American when he heard that the disreputable industrial landmark known as "Pittsburgh Plus" had been ordered out by the Federal Trade Commission. After this first sensation there was undoubtedly a feeling of satisfaction, a belief that the industrial air was clearer.

"Pittsburgh Plus" was the system of quoting prices of steel and steel products by the U. S. Steel Corporation at plants outside of Pittsburgh, using the base price plus the cost of freight from Pittsburgh to the consuming point. With its numerous plants the system gave the Steel Corporation tremendous advantage, and worked a very definite hardship on great sections of the country. That this is so may be concluded from the fact that thirty-two states had formed an association opposing Pittsburgh Plus and four of them acting under legislative authority filed briefs and argued against it.

The order forbids the Steel Corporation and its subsidiaries from quoting for sale or selling in interstate commerce steel products at Pittsburgh plus prices or from any other basing point than where they were manufactured or shipped. They must also indicate clearly on all invoices the freight charges and must not discriminate between purchasers.

It is the most important decision ever made by the Federal Trade Commission and will undoubtedly have a marked effect on methods of marketing steel products. Just what the specific effects will be, it would be unwise to predict. The commission points out that the Chicago steel user will now have the same advantage as the Pittsburgh user and that the tendency will be to decentralize steel production and steel using industries

eliminating cross-hauling that inevitably exists under Pittsburgh Plus. It further specifically claims an annual saving of $30,000,000 to the farmers of eleven middle western states. These things seem not impossible. Whatever final benefits may develop, the system was unjust and its elimination will therefore be received with satisfaction. Even if no great benefits accrued it is right that the marketing of the world's most important commodity should be placed on an equitable basis. It is for this reason that the death of Pittsburgh Plus brings with it genuine satisfaction.

How Much Does Process Steam Cost?

THE engineer who uses the exhaust steam from noncondensing engines or turbines as a source of heat for process work is often at a loss as to just how to evaluate this steam. Many are in the habit of saying that the steam would be a waste product if it were not used for heating, and hence should have no value assigned to it. This is obviously wrong, for, if the steam were not used for heating, condensers could be used with the prime movers and much of the heat in this steam be thus recovered as mechanical energy. Some who set a value on such exhaust steam do so on a basis of the power that it might have generated. Others value it on the basis of the heat it contains per pound—referred to the cost of generating a pound of high-pressure steam. Still others base the value of heat obtained from such steam on the cost of such heat when obtained by other means or from steam purchased outside the plant.

As a discussion of this problem and an exposition of procedure in its solution, we are fortunate to be able to present elsewhere in this issue an article by Tyler Fuwa, of the Massachusetts Institute of Technology. In a concise yet clear way, this article states the problem and illustrates by a simple mathematical solution the ways in which it can be solved. It should be of distinct value in helping all who use the heat of exhaust steam in their processes to determine how this steam enters into the cost of their product.

Superpower For the Northeast

UNDER the chairmanship of Secretary Hoover, the Northeastern Superpower Committee has completed its engineering study of the superpower possibilities of the northeastern section of the country and its report is made public today. The exceedingly thorough manner in which the territory covered by the report has been studied deserves the appreciation of all industry. The present and future power generating possibilities of the district are shown—by table and chart—and the future demand for power is also estimated. The method followed will, without doubt, form a model for similar studies of other districts.

However, as in all the preceding official reports upon superpower, we cannot fail to notice the omission of certain extremely important considerations. The report talks only of hydro- and steam-electric generating stations. Now the hydro-electric stations obviously should be developed to their utmost economic utility. But, as to steam-electric plants, we wish to reiterate a point made previously in these columns. The transport of raw bituminous coal by railroad is an economic waste in many cases and the burning of raw bituminous coal for power generation assumes the dimensions of an economic crime.

The report under consideration has recognized that for certain industrial districts it is cheaper to generate power at the mine mouth and transmit electricity than it is to transport the coal and generate the power at the point of use. Perhaps the time will soon arrive when high-tension transmission will be sufficiently perfected to make this true everywhere. In any case, the report should consider this probability. But, beyond that, why should the report calmly contemplate fixing the practice of burning raw coal in steam-electric plants on the country for an indefinite time—as is the obvious result of the large investment in central stations that it recommends. Why not recover the byproducts from the coal. Then, if we must have a few large steam-electric plants, rather than many smaller gas- and oil-engine plants, these could be built to burn the residual fuels from carbonizing plants rather than the untreated coal. If we must waste heat up the stack of a boiler plant, why also destroy the coal byproducts that form the foundation of such a great part of chemical industry?

Getting the Cost Idea Across to Foremen

ALL industries recognize the importance of unit cost figures in the control of production. The value of establishing a mechanism whereby costs can be promptly and accurately obtained for the management has appealed to those in charge of countless plants in many industries. To date, however, the information so obtained has been very carefully guarded. Apparently the consensus among the managers in our industries—and others—is that it is unwise to supply their foremen with cost records. Hugo Diemer, of the La Salle Extension University, has found that of 1,000 foremen in 192 different industries not more than 10 per cent are supplied with such information.

Doubtless there are many cases in which it would be unwise to take foremen into full confidence in such matters. On the other hand, when the foremen in immediate charge of production are of good type, loyal, industrious and capable in handling their departments, it seems that the management is overlooking an opportunity for cutting production costs by not placing understandable cost facts in their hands. Such information would enable the foreman to acquire the business attitude to an increasing extent—the dollars and cents perspective would make it possible for him to run his department more as a unit plant.

Even if the personnel in a given plant cannot be fully trusted with exact costs, relative figures may usually be provided, on a percentage basis, that will reveal the trend of departmental efficiency. Variations in direct labor and material charges and in various indirect charges are items that may be presented to the mutual advantage of manager and foreman.

In most chemical engineering industries this scheme has much to recommend it. In these plants there are usually several interrelated production units, often in charge of a "practical" foreman. By giving these men a better business outlook they are placed in a position to supervise more intelligently, to avoid waste time and waste material more diligently. The attitude that such a system tends to develop means much to any concern when balance sheets is made up.

Denver Meeting, American Institute of Chemical Engineers, July 15-18, 1924

Chemical Engineers Invade the Scenic West

Meeting of American Institute of Chemical Engineers in Denver Followed by Extended Western Trip Serves to Emphasize the Nation-Wide Industrial Dependence on Chemical Engineering Processes

Editorial Staff Report

WHEN all is said and done an occasional meeting of a professional society in a distant city brings with it real advantages over the more popular gathering held in the centrally located district. The extended trip develops a good fellowship and close acquaintance that from the individual's viewpoint more than compensates for the sacrifice in attendance. More important, perhaps, is the fact that such a meeting gives truly national significance to the society and broadens and makes more effective its influence on the industry and profession.

The sixteenth semi-annual meeting of the American Institute of Chemical Engineers in Denver, July 15 to 18, proved no exception to this rule. The 150 members of the Institute and their guests were well repaid for their trip in both the pleasing currency of hospitality and entertainment and in the more substantial compensation of new technical knowledge and broader appreciation of chemical engineering.

Beet Sugar the Keynote

It was fitting that the Institute should choose for the central theme of its technical sessions chemical engineering in beet sugar production. Denver is the center of a great industry indebted to the chemical engineer for much of the sturdy progress it has made in recent years. Naturally it is to him that the industry looks for the solution of many of its problems.

Waste disposal is one of these, and an important one, since the beet-sugar factory is faced with the problem of disposing of large amounts of putrefactive organic matter. A plant with 1,000 tons daily capacity has on its hands each day approximately 4,000,000 gal. of beet-sugar water, 600,000 gal. of battery waste, 150,000 of lime waste and 250,000 gal. of Steffen waste. To prevent this material from polluting streams and to make an economic use for it is the problem for the chemical engineer. Prof. Edward Bartow, head of the department of chemistry of the University of Iowa, described a method of waste disposal that is being worked out at the factory of the Northern Sugar Corporation at Mason City, Ia. At this plant a small stream afforded insufficient dilution under usual conditions and the expense of settling tanks, sprinkling filters or sand beds did not seem warranted. Preliminary experiments promised some success by settling and fermentation. Accordingly a 14.5-acre pond sufficient to store the Steffen waste of an entire season and four smaller ponds allowing 22½ days detention period for the waste waters from the diffusers and feed presses were constructed. Purification of battery waste measured in terms of reduction of dissolved residue was 64 per cent and in terms of oxygen consumed 62 per cent. Suspended matter in the Steffen waste was practically eliminated and after the close of the campaign it was allowed to flow into the stream during a period of high water. Structural improvements in the process are expected to improve the purification greatly.

In the matter of the utilization of byproducts, Professor Bartow showed samples of fertilizer containing phosphate, nitrate and potash made by evaporating superphosphate of lime and Steffen waste water in about equal proportions and finally drying the mixture in spray driers.

The papers by H. W. Dahlberg and Joseph Maudru, of the Great Western Sugar Co., dealt respectively with the barium process for the recovery of sugar from molasses and the filtration problems of the beet sugar industry. Both were published in *Chem. & Met.* last week. One of the members raised the question of barium poisoning in connection with the former process and Mr. Dahlberg pointed out that after CO_2 had

precipitated out the barium carbonate, the last trace of Ba was removed with sodium carbonate and sodium sulphate. In fact, the final sugar is spectroscopically free from this element and 20 years of successful use on the Continent has demonstrated that poisoning is not a likely danger.

Mr. Maudru referred in his paper to the 30-day experimental run that had been made on first carbonation slurry under plant conditions with the Dorr thickener. Although large-scale experimentation with this equipment was abandoned at the time, Dr. R. B. Moore, general manager of the Dorr Co., explained that the work was now being continued at the Brighton factory on a semi-plant basis. Here an effort is being made to effect automatic and continuous control of carbonation, since a uniform material at this stage of the process is fundamental. With this accomplished, the real solution of the problem is in prospect.

H. E. Zitkowski's paper on technical accounting in the sugar industry was especially well received. Prof. A. H. White, of the University of Michigan, voiced the general appreciation of the paper, particularly as it showed in a definite and concrete way the remarkable improvement in production efficiency that has resulted from continuous research over a long period. President Reese, concurring, urged upon the Institute members the importance of papers from many other chemical engineering industries that would record in a similar way the progress of technology.

It is generally admitted that the most promising direction for future development of the beet-sugar industry is along agricultural lines. The sugar content of the beet and the factors affecting it, although not strictly of a chemical engineering nature, are of fundamental importance. This subject formed the basis of a live and interesting discussion by W. H. Baird, of the Northern Sugar Corporation, and Hans Mendelsohn, of the Great Western Sugar Co. The symposium of beet sugar technology was concluded by R. W. Shafor's outstanding paper on the physical and chemical factors controlling the hot saccharate process used in the industry for recovering the final 10 to 15 per cent of sugar. (See *Chem. & Met.*, July 21, 1924, pp. 107-110).

Dust, Fume and Mist Collection

A great many articles have been written on the problem of the separation and collection of dust and fume, but it is doubtful if any are of more fundamental importance from the chemical engineer's viewpoint than was the paper of Ewald Anderson, of the Western Precipitation Co., Los Angeles. This was presented in his absence by the secretary, Dr. J. C. Olsen. Five principal methods of collecting suspended matter were classified as gravitational, inertial, filtration, spraying and electrical methods. In the gravitational method it was shown that the fundamental factor involved is the settling velocity which can be expressed by Stoke's law as $v = \frac{g\rho d^2}{kn}$ where v is the settling velocity, ρ the density of the particles, d the diameter of the particle, n the viscosity of the gas and k a constant. From this expression the settling velocities for different sized particles are shown to vary from 3 ft. per second for a 100-micron particle to 0.0003 ft. per second for a 1-micron particle. The factors involved in inertial methods were discussed and an expression, also based on Stoke's law, was given for the separating or radial velocity in a centrifugal separation. Here

$$v = \frac{d2\rho r w^2}{kn}$$

where w is the angular velocity of the gas, r the radius of the path of the particle, with the ether symbols the same as in the previous expression. It was shown that for certain material, v would be 8 ft. for 100-micron particles and 80,000 ft. for 1-micron particle.

Mr. Anderson also showed that electrical precipitation depends on the ionization of the suspended matter by the ions from the discharge electrode and on its precipitation by the electrical field. It was suggested that the important factor is not precipitation, as most writers assume, but ionization. The relative proportion of gaseous ions and suspended matter is more than 10,000 to 1. An expression based on the assumption that the rate of ionization is proportional to the concentration of suspended particles shows the relation between the percentage P precipitated in a given time and this time t as $1 - P = K^t$. That this expression is in good accord with the facts was shown by actual precipitation tests.

President Reese With Governor Charles W. Bryan, of Nebraska, a Distinguished Guest Aboard the Institute Train

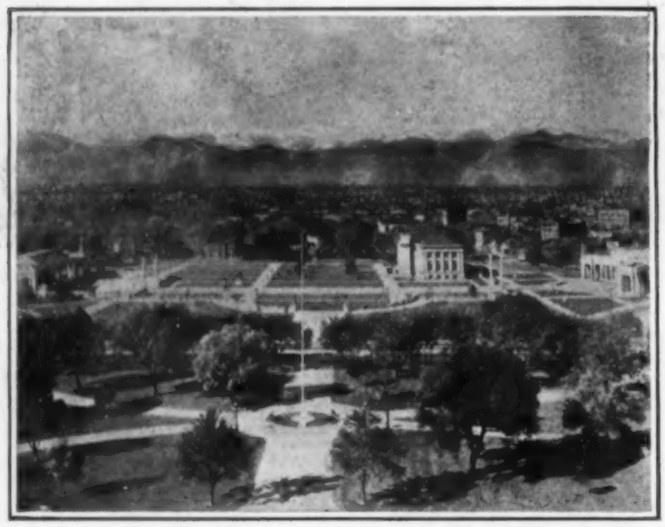
Prof. H. L. Olin, of the University of Iowa, read the paper on heat transfer in steam-jacketed evaporators. (*Chem. & Met.*, July 21, 1924, pp. 116-119.) This is the first report of work begun in 1921 dealing with an important but apparently neglected phase of the heat transfer problem. In the discussion of the paper W. L. Badger called attention to the curves in Fig. 3 showing the effect of hydrostatic head and temperature gradient. He pointed out that theoretically the curves should be parallel and suggested that if certain questionable points on the D and E curves were disregarded, the series would conform fairly well with what might be expected from the theory.

Small- and Large-Scale Acid Concentration

Some interesting results obtained with a small electrically heated silica still were reported by Prof. J. C. Olsen, of Brooklyn Polytechnic Institute. This still, which was designed and constructed by S. L. Tyler, of the Thermal Syndicate, was made entirely of silica, including the condenser, and since the heating element is also inclosed in a silica tube, the apparatus is well suited for the concentrating of corrosive acids. It is composed of three units so connected that the acid fed

into the first unit overflows into the second and then into the third unit from which the final excess drips. The three units may be operated continuously, the impurities that accumulate in the still being removed in the drip from the third unit. The paper describes a number of tests to ascertain the thermal efficiency and capacity of the still. It was found to utilize electric energy with an efficiency as high as 92 per cent. It could be used to produce distilled sulphuric or other acids of high purity, the output in the case of sulphuric acid being 145 lb. per 24 hours. Sulphuric acid may be concentrated in this still to more than 97 per cent.

A comprehensive research on the concentrating of dilute nitric acid was reported in a paper by Prof. C. D. Carpenter and Joseph A. Babor, of Columbia University. In the absence of the authors, Fred C. Zeisberg, of the Institute's publication committee, very briefly reviewed the scope of the work, pointing out that the present paper completes previous work on the relation between boiling nitric acid solutions in water and sulphuric acid. This investigation has been carried out a great deal more carefully than the work of such previous investigators as Pascal in France and Berl and Samtleben in Germany and as a result the



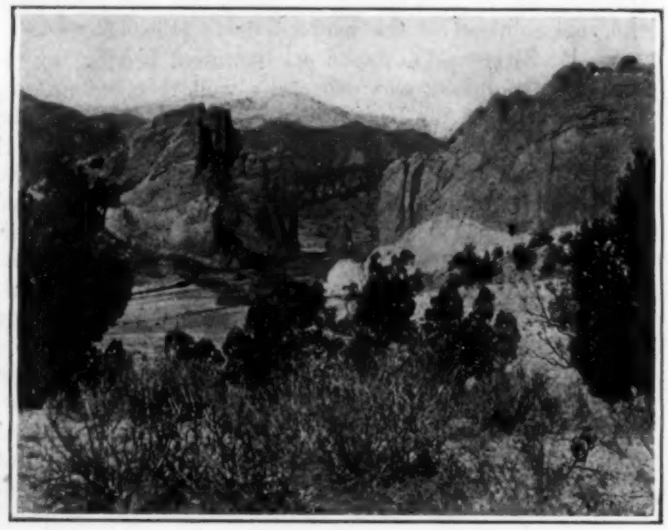
Denver's New Civic Center, With Colorado Rockies in the Background*

data are believed to be considerably more accurate. The information given in this paper, which will appear in an early issue of *Chem. & Met.*, should be useful to any engineer who has to do with the calculation and design of equipment for nitric acid concentration.

William M. Barr, for many years chief chemist for the Union Pacific Railroad, spoke of the chemical engineering aspects of water treatment for railroads. He demonstrated conclusively that the problem is peculiarly one for the chemical engineer rather than the laboratory chemist. Water treatment by the Union Pacific in a district notorious for its hard and corrosive waters has made it possible to run engines 600 to 700 miles on severe service without changing water. In fact, in a recent test run a modern type of locomotive pulling a heavy mail train made a round trip of 1,972 miles without changing water and without damaging the power plant. Mr. Barr described and illustrated a number of effective water softeners that have been developed by his company for this work.

"Refined Sulphurs: Their Manufacture and Uses" was the subject of a paper by Charles A. Newhall, consulting chemist and chemical engineer of Seattle, printed elsewhere in this issue.

C. T. Bragg and W. P. Putnam of Detroit were the authors of a short note read by W. L. Badger on the interesting Dolbear process for the separation of soluble salts from California brines. The Detroit section of the Institute had investigated this process at the request of the Better Business Bureau of the Detroit Board of Commerce. Later the Inyo Chemical Co., that controlled the rights to the process, had retained Bragg and Putnam to make a thorough investigation. The



Garden of the Gods, Colorado Springs, With Pikes Peak in the Background

preliminary results based solely on laboratory tests substantiated the claims of the process. The method is described in its essentials in two recent patents by C. E. Dolbear of Pasadena, Calif. (669,749 and 681,297, Oct. 20, 1923, and Jan. 14, 1924). It consists in drying the brine containing sodium sulphate, borax, sodium carbonate and potassium and sodium chlorides by solar evaporation and then treating the dry mixture with a hot solution which when cold is saturated with all of these salts. Advantage is taken of the fact that the solubilities of all of the salts except potassium chloride and borax remain practically unchanged when the solution is heated. The hot solution will therefore dissolve the potassium chloride and borax from the raw salts while the other sales, being no more soluble in a hot solution than when cold, remain undissolved. If the hot brine is then allowed to cool in a practically quiescent condition, the potassium chloride alone crystallizes, but when the cooled brine is agitated the borax crystallizes out and an effective separation of the two salts is thus made. The leached salts are leached with a sodium chloride solution to dissolve out the sodium carbonate and sulphate and then CO_2 is bubbled into the brine to convert the carbonate to bicarbonate, which is insoluble and precipitates out. Finally, the remaining brine containing the sodium chloride and sulphate is subjected to the action of ammonia gas, which when it reaches a concentration of 24 per cent causes all of the sodium sulphate to precipitate in anhydrous condition. Larger scale investiga-

*For the courtesy of using these photographs *Chem. & Met.* wishes to acknowledge its indebtedness to a former Denver representative of *Coal Age*, Warren E. Boyer, now of the Denver Tourist Bureau.

tions are now being made by the authors and will be reported later.

A. R. Chandler, of the Universal Oil Products Co., with Gustav Egloff, had prepared a comprehensive paper on recent technical advancements in the California petroleum industry. The review had to do with many interesting developments in oil production, transportation and refining.

Two of the most interesting papers of the meeting were from the Dorr Co. The first by John V. N. Dorr, on progress in the application of hydrometallurgical methods in the chemical industry, was read by Dr. R. B. Moore. It described in a general way the striking advances made during the past 10 years in adapting the continuous methods of sedimentation, classification and dissolution to a score or more of chemical industries, notably sugar, alum, barium sulphide and lithopone, phosphoric acid, caustic soda, salt and paper.

Silver Plume, Colorado, A Typical Mining Center in the Denver District

It is impossible here to report the details of the different processes, but the complete paper will be published in a later issue of *Chem. & Met.* The second paper, read by G. W. Repetti, of the Dorr Co., was a discussion by Frank Bachmann of the treatment of industrial wastes to prevent stream pollution. Bachmann referred to the growing effort of local, state and federal authorities in forcing upon industry the burden of caring for its wastes. The modern plant manager recognizes this responsibility as a part of production and provides for it accordingly. There are three principal methods for waste treatment: (1) Dilution, (2) sedimentation with or without screening and (3) biologic. The first can be used, of course, only where a sufficient volume of water is available or, as is the case in some states, where the authorities have set aside certain streams for this explicit purpose. The development of the Dorr sewage clarifier as a modification of the thickener has resulted from the demand for a compact apparatus that would give by continuous operation as thick a sludge as possible. The Dorrco screen used in conjunction with the sedimentation process is mechanically operated and self-cleaning.

Colored Pipe Lines

The two business sessions of the Institute were reported last week in the news columns of *Chem. & Met.* Crosby Field, of the National Aniline and Chemical Co., reported for the committee on the standardization and identification of pipe lines by means of color. In this work thirty-eight technical societies are co-operating and are expected shortly to report a uniform scheme of marking that should prove of great value particularly in the case of emergencies such as fire make it necessary for an outsider to take control of a strange plant. Mr. Field will prepare an abstract of the committee's report for later publication. Another committee report of importance to the chemical engineering industries is on the evaporator test code worked out in conjunction with a committee from the American Society of Mechanical Engineers. A difference of opinion existed between the two organizations regarding the type of code to be adopted, since the mechanical engineers insisted upon a detailed formula based on a definition of so-called evaporator efficiency that was not acceptable to the Institute's representatives. A compromise arrangement was finally effected and the joint committee's recommendations are to be published. Prof. W. L. Badger, of the University of Michigan, has agreed to prepare an interpretation of this report for publication in *Chem. & Met.*

Delightful Social Features of the Trip

An account of the Denver meeting would be incomplete without reference to the hospitable treatment accorded the visitors. The good times began on the special train that brought fifty-seven members and their guests from the East. It failed to be interrupted by a wreck at Van Wert, Ohio, resulting in more than 2 hours delay. A distinguished guest aboard the train was Governor Charles W. Bryan of Nebraska, who was returning from the Democratic convention that had nominated him for Vice-President of the United States. At Chicago the party was met by local members of the Institute, who provided a sight-seeing trip about the city, and later a pleasant dinner on the roof of Hotel Lasalle. The next day a 2-hour stop at Omaha gave William M. Barr and his associates an opportunity to show the Institute the wonders of the Nebraska city.

To recount the many delightful features of the program provided by the Denver entertainment committee would require an accounting for practically every minute of the 4 days visit.

S. D. Kirkpatrick, of Chem. & Met.

A word of appreciation is due the five members of the Institute whose work made the convention possible. R. W. Shafor, Joseph Maudru, W. C. Graham, H. W. Dahlberg and W. M. Barr earned for themselves the gratitude of all who attended the meeting. Further thanks must go to the wives of the members who ably entertained the ladies of the convention and to the many firms that shared in the expense of the meeting. By their action they have established a record openhearted hospitality.

Production and Use of Refined Sulphur

A Discussion of the Technology of Manufacturing Refined Sulphur and of the Advantages and Methods of Commercial Utilization

By Charles A. Newhall
Consulting Chemist and Chemical Engineer, Seattle, Wash.

It is to be owned that many things have been writ of Sulphur; but the true Foundation of the Virtues thereof has scarcely yet by man been exactly enough touched or proposed.

Whosoever shall attempt to describe Sulphur in a most accurate manner (as is fit, though not expedient) will have need of abundance of paper.

—From an ancient writer quoted in "Sulphur and Sulphur Derivatives," by H. A. Auden; Sir Isaac Pitman & Sons, Ltd., London.

SINCE these words were put on paper many centuries ago, very much has been added to the "many things that have been writ of Sulphur." Yet it is surprising how little there is of record concerning the commercial and technical aspects of the refined sulphur industry. Perhaps in the past those engaged in the industry have felt it to their interests to be reticent rather than to use an "abundance of paper" in setting forth the virtues of their product; they trusting, no doubt, that the recognized merits of refined sulphur would be sufficient to sell the output of their refineries.

The use of refined sulphur is increasing steadily and rapidly. American refineries turn out something like 50,000 tons per year and foreign refineries probably double this tonnage. It therefore accounts for considerably more than 10 per cent of the total world sulphur consumption, estimated at about 1,000,000 tons per annum. The American refineries and those in Europe about which I have information have their output well disposed of and their refining equipment is being enlarged. Yet within recent years a considerable controversy has arisen as to the merits of refined sulphur as compared with other grades manufactured directly from crude sulphur without refining. This controversy is hurting all branches of the sulphur industry and, if continued, is certain to retard materially the normal increase in sulphur consumption. To my way of thinking this controversy is largely due to a lack of understanding within the industry as to the physical and chemical properties and the proper uses of the different grades of refined and crude sulphur. In this paper I shall endeavor to point out the differences in the several sulphurs that enter into commerce; dealing especially with the refined grades, as the crude forms have already been ably described in the *Transactions* of the Institute. In doing this something must be said about the construction and operation of sulphur refineries, although I must confess that my remarks on this ancient and very interesting phase of the sulphur industry will be but general in nature, as matters of expediency still govern the public discussion of this part of the subject.

The most thorough paper published in recent years on the sulphur industry was read before members of the Institute at the New Orleans meeting.[1] However, in this very interesting paper but little is said about the use of refined sulphur. The article tends to leave the impression that the raw sulphur as produced in the Gulf fields is suitable for most if not all purposes.

Production of Refined Sulphur

The principal factors in the sulphur industry still follow the ancient methods in use for hundreds of years. Nearly four centuries ago Robert Boyle, in his "Sceptical Chymist," quite accurately though briefly describes the essentials of sulphur refining: "Common sulphur (if it be pure and freed from its vinegar) being leisurely sublimed in a close vessel, rises into dry flowers, which may be presently melted into a body of the same nature with that which afforded them." During the centuries in which refined sulphur has been an indispensable article of commerce, the refining process has remained essentially the same, though there has been a gradual increase in the size of the retort, as we now term it.

Figs. 1 and 2 show two forms of French sublimers. As described by Guttmann these sublimers consist essentially of iron retorts that hold several hundred pounds of molten sulphur, these are filled from a kettle that is used to melt and dry the crude sulphur. Each retort is connected with its condensing chambers by an iron flue, which serves as a sort of reflux condenser. One type of retort is described as a simple cylinder 20 in. in diameter and 5 ft. long. Another type of retort is lenticular in cross-section.

The condensing chamber is described as being square and of about 3,000 cu.ft. volume. It is equipped with a

Fig. 1—A French Sulphur Sublimer (After Guttmann)

Prepared from a paper presented at the Denver meeting of the American Institute of Chemical Engineers, July, 1924.

[1] "Recent Advances in the American Sulphur Industry," by R. F. Bacon and H. S. Davis, *Trans. Am. Inst. Chem. Eng.*, vol. 13, Part 2.

heavy safety valve. When the temperature in the chamber is kept below 100 deg. C. flowers of sulphur are deposited. If the temperature is allowed to rise higher than 100 deg. C., the sulphur vapor condenses as liquid and is drawn off and cast into blocks.

The Italian equipment discussed by Molinari is similar to Fig. 1, as described by Guttmann. Two retorts subliming into one chamber produce about 1.8 tons of sublimed sulphur each 24 hours.

Guttmann describes an English sublimer, Fig. 3, that is quite different in construction from the French and Italian type. This English equipment is apparently adapted principally to the production of brimstone rather than flowers. In the figure *a* is a metal kettle containing the molten sulphur. As the temperature rises the sulphur vapor first formed is carried through the large pipe *e* into the condensing chamber *c*, in which the sulphur deposits as flowers. As the temperature in *a* rises and the vapor becomes heated, the valve *f* is closed and f_1 is opened, thus diverting the sulphur vapor into the pot *b*, where it condenses as molten sulphur. The molten sulphur is bailed out and cast into blocks. The flowers, which contain acid and are thus unsuited for explosive work, are remelted along with raw sulphur.

Fig. 4 shows the exterior of a small modern refinery and indicates the massive type of construction that is essential if a high-grade product is to be produced. Figs. 6 and 7 show interior views of the sublimer room. Fig. 5 shows diagrammatically a modern sulphur sublimer. The crude sulphur is dumped into the kettle, where it is melted by heat from the furnace. The molten sulphur after being freed from moisture and the light impurities that rise to the surface and are skimmed off in the kettle, is dropped through the plug valve into the retort. This retort is flat bottomed and arched at the top in shape much like the fireclay muffles used in the benches of the old-style gas producers. The front end of the retort is equipped with a cleaning door and with suitable plug cocks for testing the level of the molten sulphur within the retort. The sulphur vapors rise through a long "goose neck" and enter the chamber.

The chambers in a modern refinery are immense vaulted rooms of volume up to 30,000 cu.ft. or more where flowers of sulphur is the desired product. Where roll sulphur or brimstone is the product desired, the chambers are small affairs similar to the European type described by Guttmann and Molinari.

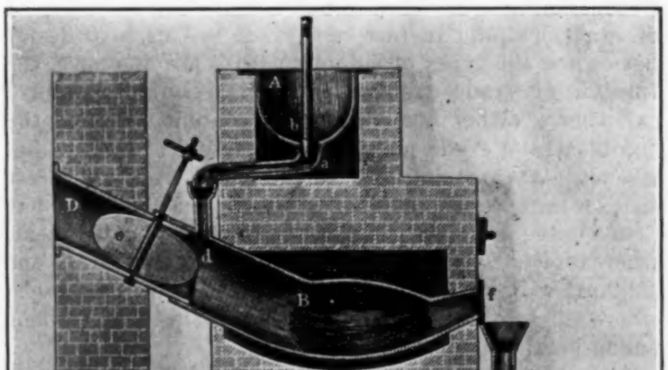


Fig. 2—Modified French Sublimer (From Guttmann)

In the construction and setting of the kettle, retort and goose neck, extreme care is exercised to guard against breaks and leaks. Special construction is used to make the chambers practically vapor tight. Sulphur vapor and sulphur dust are explosive and flammable in the extreme, and therefore leaky equipment must be guarded against. Another danger that is unusually troublesome in sulphur work is the action of static electricity, which is the cause of fires and explosions at frequent intervals. This source of trouble apparently

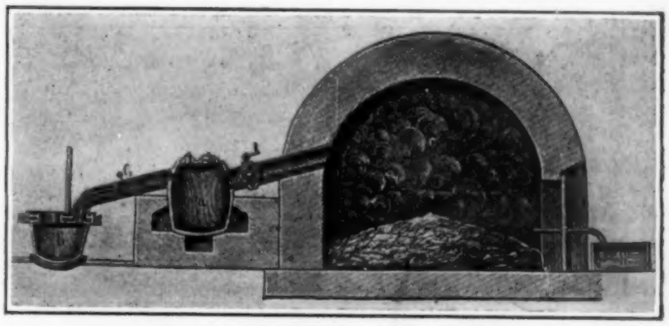


Fig. 3—An English Sulphur Sublimer

can not be entirely prevented, but the effects can be confined to small units and thus great damage avoided.

A single sublimer unit producing approximately 4 tons of sublimed sulphur each 24 hours, together with the essential accessory equipment to convey, pulverize and pack the products, costs something like $50,000. The largest refinery I know of consists of seven units for producing flowers and one unit for producing brimstone or roll sulphur.

Operating a Refinery

In making sublimed sulphur the operating cycle consists in melting the sulphur, skimming, subliming, condensing, "gassing" or cooling the chamber, unloading the chamber and finally cleaning the residue from the retort. The operations are so balanced and conducted that one cycle follows another in practically continuous succession from month to month until a leak develops or a retort cracks or like trouble occurs that calls or a shutdown and repairs. Of course, the operation varies somewhat, depending on the kind of crude sulphur being worked.

In the first step of melting the sulphur the temperature must be raised high enough to drive off all moisture and volatile acid or the "vinegar," as Boyle terms it. Also this step should char the organic matter present in the sulphur, yet the temperature should not be raised so high as to make the sulphur pass into the viscous modification, as it would then be difficult to handle. Moisture and volatile matter if allowed to enter the retort with the sulphur will cause spurting during the subliming operation.

In the second operation of skimming, the reader would be surprised to see the volume of asphalt and wood that is taken from even the "99.5 per cent pure" crude sulphur from the Gulf fields, which is the product now mostly refined. Formerly Italian and Japanese sulphur was the principal crude refined on the Pacific coast, but now no Italian crude comes in and only occasional shipments of Japanese. Naturally the source of the sulphur and the impurities present determine the amount of material removed at this step.

The most difficult operations in the whole cycle are the "subliming" or boiling and the condensing of the

sulphur. This subliming is carefully watched by experienced operators and is checked by indicating pyrometers in the most modern plants. The splendid research of Alexander Smith[2] and his associates has done a great deal to explain the behavior of sulphur when heated to high temperatures and then suddenly cooled. As far as I am aware the sulphur industry, strange to relate, does not know of this beautiful piece of pure scientific research. Yet the practical application of many of the points investigated would undoubtedly mean millions of dollars each year added to the income of the sulphur

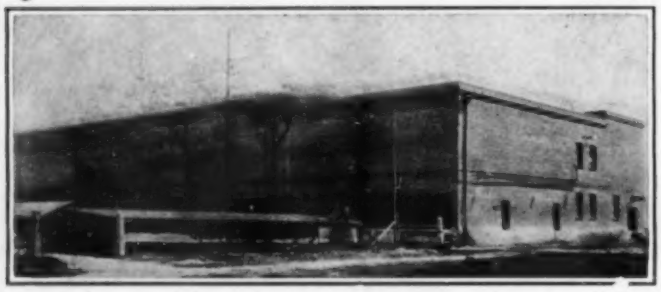


Fig. 4—A Small Modern Sulphur Refinery

producers and refiners and at the same time would give the sulphur consumers a superior product.

Some of the points made clear by Dr. Smith and his workers have been discovered through the very costly cut and try methods many years ago in the sulphur industry. For instance, it has long been recognized that the presence of sulphur dioxide was needed in the chambers in order to secure the highest quality flowers. It has also been known that the temperature and velocity of the sulphur vapor on entering the chamber had some bearing on the quality of the product.

During the third and fourth stages of the cycle the operator can control the percentage of "acidity" that is developed in the flowers of sulphur. This percentage of acidity has an important bearing on the value of the product. Acidity in terms of H_2SO_4 is usually held between 0.20 per cent and 0.50 per cent when the flowers

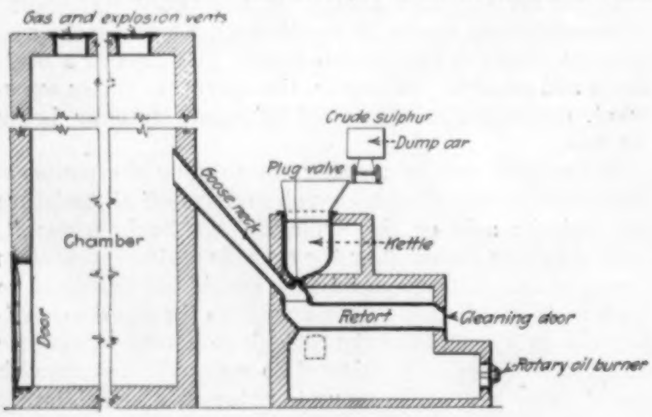


Fig. 5—Modern Sulphur Sublimer

are to be used in the agricultural districts for control of mildew and insect pests by the dry dusting method. The acidity could be run up much higher by proper methods, but such high acidity would cause the containers to corrode and also would develop a poor mechanical behavior in the dusting machines. Irregular acidity is one of the bad features of a poorly operated refinery.

When the doors and vents of a chamber are unsealed, it is found that the finest, fluffiest, "velvety" flowers containing the highest percentage of amorphous sulphur are deposited at a distance from the goose neck. Nearer the goose neck the flowers are heavier and "rougher." Directly under the gooseneck the sulphur is in a solid mass like frozen snow or ice. In some refineries the entire content of the chamber is mixed together and after running through beater type mills and being bolted is sold as sublimed flowers of sulphur, this practice giving a very inferior product, however.

In the larger refineries the content of the chamber is very carefully separated into three or more grades. Only that material is marketed as flowers of sulphur that shows a bulk of over 74 deg. Chancel,[3] or as packed in bags or barrels a bulk of about 30 lb. per cubic foot, and a content of amorphous sulphur of at least 30 per cent.

The heavier material from the chambers is run through granulator and beater mills and bolted or air (or gas) separated or sold in lump form. The bolted product is sold under the trade designations (American Pacific Coast) "Flour Sulphur" or "Powdered Sublimed Sulphur"; the air separated product as "Ventilated Sulphur" or in the East Coast markets as "Superfine Re-

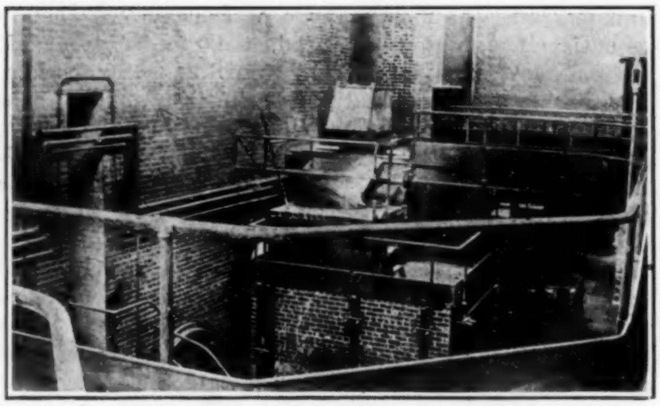


Fig. 6—Sulphur Refinery Showing Charging Hopper and Kettle Over Retort Housing

fined Sulphur"; while the heavy product is marketed under the various designations of "Heavy Flowers," "Refined Lump," "Virgin Lump," "Lump Brimstone" and the like. As stated before, Molinari gives seventeen distinct types of sulphur sold on the Italian market. Other markets have an equally confusing number of designations, and in fact each trade has its own designation for the types of sulphur used. For instance, the fumigating trade can use a "Refined Lump Sulphur" carrying a rather heavy arsenical content, whereas the hop bleaching trade must have an arsenical content below ten parts per million. In the latter trade the presence of minute amounts of asphaltic matter is of but little consequence, as the sulphur is burned under heat, whereas even 0.004 per cent of asphaltic matter in the sulphur will cause trouble in the fumigating trades where sulphur must be burnt in open dishes and without undue heating.

In making the sublimed flowers of sulphur in the big chambers the time of the subliming step is so regulated that the desired proportion of high-grade flowers is produced in each cycle. A well-operated sublimer should turn out at least 50 per cent of the highest grade flowers and the remainder divided about equally between

[2]University of Chicago Decennial Publications, 1st series, vol. 14, page 55; *Berichte*, vol. 35, page 2992; *J. Am. Chem. Soc.*, vol. 27, page 797; same, vol. 29, page 1032.

[3]For Chancel's test see Lunge, "Sulphuric Acid and Alkali," Vol. I., Part I, page 47 (1913 edition).

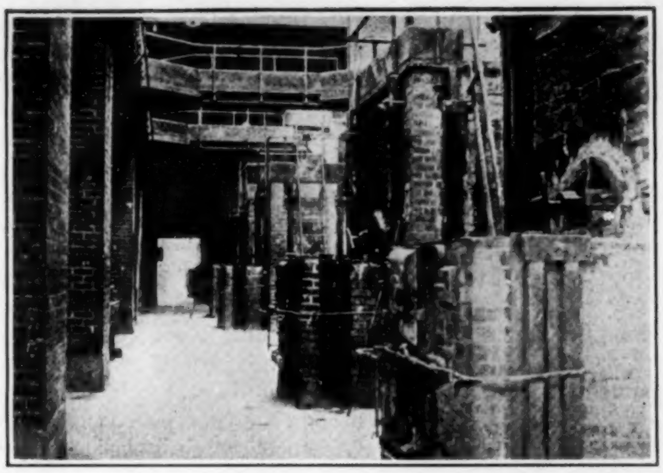


Fig. 7—Retorts (Cleaning End) and Furnaces

lump sulphur and the heavier flowers. A chamber could be operated to turn out 100 per cent flowers of the highest grade, but such operation would not usually be profitable under the ordinary commercial conditions.

When the purpose of the subliming operation is to make refined brimstone or roll sulphur, the small chamber is used and the temperature within kept close to the melting point of sulphur. Often this grade of sulphur is made by remelting and resubliming the heavy grades from the big chambers. The chamber is not opened at the end of the subliming stage, but the liquid sulphur is drawn off from the sump of the chamber as fast as the sulphur is either cast directly into the conical 3-lb. sticks and sold as roll sulphur or brimstone or is run into blocks and cooled. These blocks are broken up and granulated, pulverized in beater type mills, bolted or air separated and sold to the trade that require an acid-free 100 per cent rhombic product. In this operation of making refined brimstone the essential operations are concerned with the removal of all moisture and acidity and the production of 100 per cent rhombic sulphur instead of the production of as high as possible percentage of amorphous sulphur, as is the case in making flowers.

Precipitated Sulphur

So far in this paper I have described the manufacture of refined brimstone and the manufacture of flowers of sulphur. A third form of refined sulphur commonly called "precipitated sulphur" enters commerce in limited amounts. This form is made not by sublimation but by precipitation from soluble polysulphides. In the drug trades this form of sulphur is called "Magister of Sulphur" or "Lac Sulphur."

While this precipitated sulphur has but little interest for the refiner on account of the limited amount used, it is of much interest to one studying the physics and chemistry of sulphur. In passing I should also note that indirectly this form of sulphur is of immense importance to the agriculturist, as it is this form of sulphur that is deposited on the plant after spraying with lime sulphur solution and is the lethal agent of this important insecticide and fungicide.

Commercial Applications

Molinari states that the first commercial subliming plant was constructed in Marseilles, France, in 1805. In America subliming plants have been in operation on the Pacific coast for nearly half a century, these plants furnishing the rhombic form of sulphur required by the powder mills that were built in the early days to cater to the mining industry of California. A bit later the French and Italian vineyardists that pioneered in the agricultural development of the Golden State required the flowers of sulphur, the merits of which had long been recognized in their home countries. In comparatively recent years the rubber trade is taking an immense tonnage of rhombic sulphur, the principal consumers buying under very rigid specifications as to low content of amorphous sulphur and freedom from acidity and impurities. Thus the demand for refined sulphur is shifting from the Pacific coast and becoming more and more nation-wide. Eastern agriculturists as yet do not know the merits of high-grade sublimed flowers of sulphur so long recognized by their European and Californian co-workers. The sulphur refineries in the East have mainly catered to the trades that use the rhombic sulphurs and only a comparatively small tonnage of flowers is produced, this mainly for the demands of the drug trade.

The first commercially important use of sulphur was of course in the manufacture of black gunpowder. For this purpose it is essential that the sulphur be of pure rhombic form, as this is the stable form and can be produced free from acidity. For this purpose sulphur has been refined for centuries. The first refining methods probably consisted in simple melting whereby the moisture and easily volatile impurities were removed. Later on crude subliming methods were undoubtedly used in order to free sulphur from the ore and thus the merits of sublimed sulphur became known.

Sulphur as a Fertilizer and Insecticide

In the notable experiments by Reimer and Powers in Oregon started in 1912 finely pulverized sublimed sulphur was used. In this work these scientists established that the use of this form of sulphur in the soil in quantities from a few pounds up to several hundred pounds per acre would bring about a tremendous increase in many crops. In the practical application of this now famous research the pulverized rhombic sulphur was at first exclusively used. with remarkable success; in some Oregon soils the yield of alfalfa being increased several hundred fold. The yield from the total alfalfa acreage has been doubled by the use of sulphur with only about half of the acreage having yet been treated. In later years different forms and combinations of sulphur have been tried in soil work with varying results.

The agricultural use of sulphur calls for much more practical study than has been given to date. Sulphur does not always act in the soil as expected. Many conditions, as yet more or less obscure, affect the results. Only careful practical work supported jointly by the sulphur industry and the agricultural interests can bring the benefits that certainly will result for both the consumer and producers of sulphur. To date there has been too much wasted effort in poorly considered investigations as to the use of agricultural sulphurs.

The manufacture of insecticides, especially lime sulphur, accounts for a large tonnage of powdered sublimed sulphur. This important insecticide and fungicide was at first made almost exclusively from the refined grades of sulphur. In recent years only the small manufacturer and the "home boiler" use refined grades, whereas the large commercial manufacturer uses the crude grades of sulphur. There is a great deal of practical evidence to show that the use of crude sulphur, or perhaps the processes common where this grade is used, give a lime

sulphur solution that has properties quite inferior to the solution made from refined sulphurs. There is some scientific evidence also tending to support the practical evidence. The question is now rather controversial because of lack of scientific data. Sufficient to say that lime sulphur solution made from crude sulphur is rapidly falling into disfavor with the practical agriculturist and non-sulphurous substitutes are being used in increasing quantity. One eminent and practical agriculturist advises me privately that he expects that within 5 years the inroads of substitutes will cut the tonnage of crude sulphur used in the lime sulphur industry squarely in two.

Food Preservation

One of the oldest uses of sublimed sulphurs—both flowers and rhombic—is the sulphuring of fruit and other food products. Millions of dollars worth of agricultural products are thus sterilized and preserved in their natural purity. Some of us no doubt remember the hectic controversy of a score of years ago over the so-called bleaching of fruit by the use of sulphur. The use of excessive amounts of improperly refined or even crude sulphurs in early days certainly was open to condemnation. It has now been established that the sulphuring of fruit by modern methods and with high-grade sublimed rhombic sulphur or flowers is as healthful a form of sterilization as is the use of heat.

In recent years our ideas of what really constitutes preservation by sulphuring has changed somewhat. We formerly thought that sulphur dioxide was the sole effective agent. Now we have some interesting evidence that sulphur vapor itself or some, as yet obscure, sulphurous compound other than SO_2 also plays an important part. Strange to relate, the burning of crude sulphur, even of 99.5 per cent purity, has been shown under some common condition to give an entirely different and inferior result than when flowers of sulphur are used under identical conditions. Practical orchardists have long held for the superiority of flowers of sulphur over all other sulphuring agents.

The Uses of Flowers of Sulphur

We now take up the properties and uses of sublimed flowers of sulphur; the most important of all refined sulphurs. Strictly speaking, the term sublimed is a misnomer. Sulphur does sublime rather easily and at temperatures many degrees below its boiling point. There is some evidence that sublimate is formed even as low as 20 deg. C. The sulphur vapor when in exceedingly minute quantity has an odor much like camphor. At higher concentrations the vapors are very irritating to the nose and eyes, although the nerves soon become deadened to the effects and the discomfort is no longer apparent.

The so-called sublimation process is really a distillation, as the sulphur vapor is superheated well above the boiling point at all times. I have never seen any sulphur crystals on the inner walls of a chamber, although beautiful snow-flake like crystals often form around the kettle and retort housings. The sulphur vapor condenses in the chamber in the form of very minute spherical droplets and not in crystals, as is so often stated in the literature. Under the microscope, as noted above, the structure of the flowers is clearly apparent as a mass of these spherical droplets all of uniform size. The highest grade flowers consist of droplets that are free from each other or barely touch. In the heavier flowers the higher temperature in the chamber toward the end of the sublimation period has caused these droplets to coalesce or even fuse together.

I do not know of any research covering the physics of flowers of sulphur. Alexander Smith and his co-workers in the literature previously referred to have shown that the solid sulphur formed when liquid sulphur is suddenly cooled from near the boiling point, consists of amorphous sulphur up to about 34.2 per cent together with rhombic sulphur. This is about the same percentage of amorphous sulphur found in the highest grade flowers. Very likely sulphur vapor when it condenses gives exactly the same mixture of rhombic and amorphous sulphur as does liquid on cooling from a high temperature. According to this research, amorphous sulphur when first formed is liquid even at room temperatures and this liquid state persists for some time. Droplets of amorphous sulphur when observed under the microscope were first liquid; they then solidify, with a later change to monoclinic system, although still in the spherical form. Finally, the droplets suddenly change from the monoclinic to the stable rhombic system. All this occurs at room temperature. This amorphous sulphur is a most unusual substance. It is a sort of coiled spring or a source of potential energy, for it should be recalled that each change from the amorphous through the monoclinic to the stable rhombic form is accompanied by the liberation of heat and a reduction of volume.

This unusual property of amorphous sulphur undoubtedly is the reason for the superiority of flowers of sulphur as a sulphuring agent in food sterilization and as a dust insecticide and fungicide, when compared with pulverized rhombic sulphur, even though the particles of the latter are many times smaller than the droplets of the flowers. In making this statement I am fully aware that I am laying myself open to the charge of bringing controversial matter before the members of this Institute, for it should be known that in recent years the agriculturist has been very strongly solicited to purchase both crude and refined grades of pulverized sulphur. Molinari and other eminent men have stated

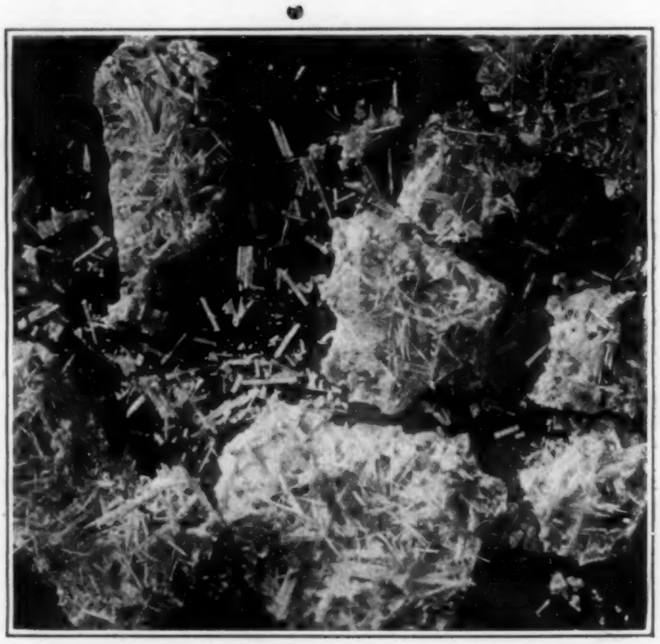
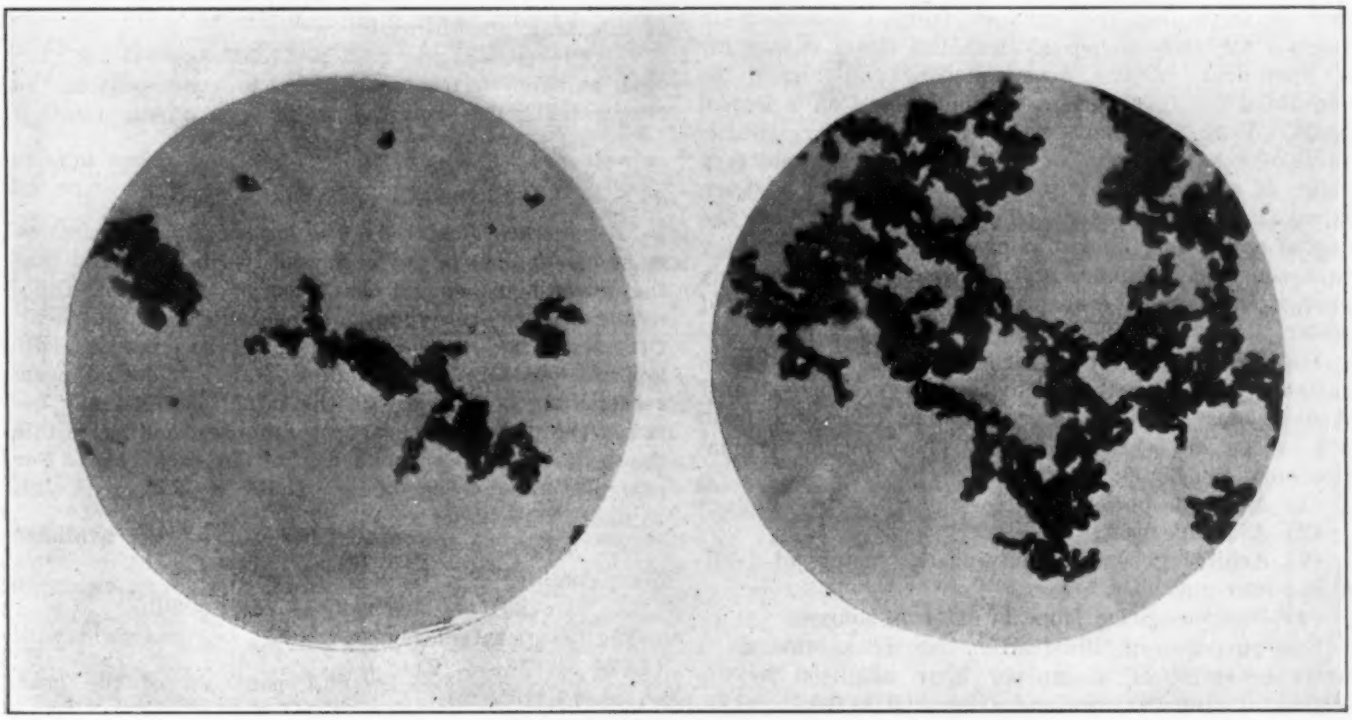


Fig. 8—Characteristic Needle Crystals of Brown Monoclinic Sulphur

that finely pulverized sulphur is superior to flowers in the control of the mildew of the grape. A recent bulletin[4] giving a brilliant piece of research on the toxicity of some sulphur fungicides completely ignores the flowers of sulphur. Yet the tonnage of flowers of sulphur used as a food sulphuring agent and as a dust insecticide and fungicide many times exceeds the tonnage of all other forms of sulphur used for similar purposes. My statement as to the superiority of flowers of sulphur for these uses is borne out by the experience of thousands of practical agriculturists both in Europe and America, where powdered sulphur has at all times been obtainable at about the same price as flowers.



Figs. 9 and 10—Comparison of Ground Rhombic Sulphur and High-Grade Sublimed Flowers of Sulphur
Left—A few particles of ground rhombic sulphur showing sharp fractures. Right (same magnification)—A single particle of high-grade sublimed flowers of sulphur. Note the agglomeration of a great number of spherical droplets.

Likely the commercial reason for the urge to dispose of powdered grades of sulphur is accountable by the fact that it takes only hundreds of dollars to set up a grinding plant, whereas it takes thousands to produce flowers and sublimed grades. The reason for the difference of opinion among specialists is not quite so easy to explain. I think most likely that opinions have been based on evidence obtained without due knowledge of the very wide range in quality of commercial sulphur of even the same trade designations. For instance, I know of one opinion that was based on a comparison between a very inferior powdered sulphur and high-grade flowers, and another opinion was based on conditions exactly the reverse. Also comparisons have been made under laboratory conditions and in the absence of sunlight, which appears to be an essential factor in the effective use of dust sulphur whether flowers or pulverized.

Just what happens when sulphur is used as an insecticide and fungicide is not clearly understood. There is room for a lot of profitable and interesting research. Doran in the paper cited above shows that oxygen is essential under the conditions of his tests, and he infers that sulphur dioxide is the lethal agent. On this basis the more powerful action of flowers is explained, for the action of sunlight undoubtedly starts the reversion of the amorphous sulphur. In this change from the amorphous to the rhombic form each droplet of the flowers is shattered by a shrinkage and an immense surface is exposed to the air. At the same time the heat set free by the reversion must promote the union of the sulphur with the oxygen of the air. All practical agriculturists are aware that sulphur "fumes" best on a bright sunny day.

Powdered sulphur, no matter how finely ground, could never have the surface that is developed when the droplets of the flowers are shattered by the reversion. There is also much practical evidence to show that the small percentage of "acid" always present in the flowers has an important bearing on the "fuming" properties of flowers. Probably the acid helps start the reversion or helps to preserve the amorphous form till the sunlight unbalances a state of equilibrium that is known to exist among the amorphous sulphur, the rhombic sulphur and SO_2. The acid also undoubtedly has a marked lethal action in itself.

Anyone who has worked around a sulphur refinery and suffered from the effects of sulphur vapor, will be inclined to attribute a high lethal value to the vapor itself (in spite of the evidence cited above that oxygen is necessary). Very little is known about the vaporization of sulphur under conditions of sunlight and field temperatures.

There are numerous other uses of the several forms of sulphur that I have not mentioned, and one could go on for hours describing the many uses and interesting properties that I have not touched upon. I have brought out the principal points interesting from a technical and commercial point of view. To paraphrase the words of the ancient writer quoted at the beginning of my paper: The virtues of this strange and important element—sulphur—have scarcely yet been proposed.

[4]"Laboratory Studies of the Toxicity of Some Sulphur Fungicides," by W. L. Doran, Technical Bulletin 19, New Hampshire Agricultural Experiment Station, Durham, N. H.

How Shall We Calculate the Cost of Exhaust Steam?

A Comparison of Four Possible Bases of Evaluating Exhaust Steam and a Discussion of the Advantages of Each

By Tyler Fuwa
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IN PLANTS where large quantities of low-pressure steam are necessary for process work, the usual practice is to utilize the exhaust from non-condensing engines for such purposes. Exhaust steam is sensibly a byproduct of the power house, and should be accounted for in an accurate manner and on a logical basis. Very few plant men agree, however, on the value of exhaust steam. Usually some purely arbitrary value is assigned, and in many instances such steam is called a waste product. The result is that both the cost of power and the cost of production may be in error to a considerable extent. This would be true in any process involving the evaporation of large amounts of water, as for example in the recovery of salt.

The question naturally arises, What constitutes a rational basis for the evaluation of exhaust steam? A number of such bases are possible, depending upon our conception of the problem. These include evaluation on the basis of:

(1) Available power.
(2) Available heat.
(3) Arbitrary basis, combining the factors of available power and heat.
(4) Purchase price from an external source.

For purposes of illustration, let us assume as a basis 1,000 lb. of steam per hour admitted to the engines at 160 lb. gage and exhausted at 10 lb. gage. The exhaust is used in an evaporator, and is finally condensed at 27-in. vacuum, referred to a 30-in. barometer. The overall cost of steam is 80c. per 1,000 lb., and cooling water is available at a cost of 5c. per 1,000 cu.ft. Heat losses by radiation are to be neglected.

1. *Power Basis*—The heat content of 160 lb. gage steam is 1,196 B.t.u./lb. and of 10 lb. gage steam, 1,160 B.t.u./lb.; hence, for a steam consumption of 1,000 lb./hour the theoretical power between these limits is

$$\frac{(1{,}196 - 1{,}160)\ (1{,}000)\ (777.5)}{(550)\ (60)\ (60)} = 14.1 \text{ hp.-hr.}$$

Since the heat content of steam at 27-in. vacuum is 1,109 B.t.u./lb., the theoretical power between 10-lb. gage and 27-in. vacuum is

$$\frac{(1{,}160 - 1{,}109)\ (1{,}000)\ (777.5)}{(550)\ (60)\ (60)} = 20.0 \text{ hp.-hr.}$$

The cost of condensing, including cooling water, power for accessories and fixed charges, is assumed to be 5c. per 1,000 lb. of steam.

Since the engines use directly $\frac{(14.1)\ (100)}{14.1 + 20.0} = 41.3$ per cent of the theoretical power available from the steam, the power house should be charged for this at the rate of

$$(80)\ (0.413) = 33.1\text{c. per } 1{,}000 \text{ lb.}$$

The evaporator house uses the remainder of the theoretical potential power, and therefore should be charged

$$(80)\ (0.587) = 46.9\text{c. per } 1{,}000 \text{ lb.}$$

However, the evaporator house is performing a condensing service worth 5c. per 1,000 lb. of steam, and should be credited with this amount. Likewise the power house should be charged 5c. Any computation of the cost of power should take this cost of condensation into account, regardless of the basis used to calculate the cost of exhaust steam.

2. *Heat Basis*—The total heat used by the power and evaporator houses amounts to the total heat of the steam at 160 lb. gage, 1,196 B.t.u., less the heat of the liquid at 27-in. vacuum, 83 B.t.u., or 1,113 B.t.u. The power house uses $\frac{(1{,}196 - 1{,}160)}{(1{,}113)}$ or 3.23 per cent of this heat, amounting to

$$(80)\ (0.0323) = 2.6\text{c. per } 1{,}000 \text{ lb. of steam}$$

In addition to the heat down to condensation, the evaporator house uses the latent heat of vaporization as well, $\frac{1{,}160 - 83}{1{,}113}$ or 96.8 per cent, which amounts to

$$(80)\ (0.968) = 77.4\text{c. per } 1{,}000 \text{ lb.}$$

3. *Arbitrary Basis*—The latent heat of vaporization must be supplied in any case, and it can be argued that the power house should bear some of the cost of evaporating water, even though it uses none of that heat. Otherwise, the steam cost for power becomes absurdly low, as seen in the foregoing plan. It would seem reasonable, then, to divide the latent heat equally between the power and evaporator houses, adding to this the heat used above condensation in each case. For example, the power house would be charged with $\frac{(1{,}026 \div 2) + 36}{1{,}113}$ or 49.3 per cent of the available heat, costing

$$(80)\ (0.493) = 39.5\text{c. per } 1{,}000 \text{ lb.}$$

The evaporator house would be charged with $\frac{(1{,}026 \div 2) + 51}{1{,}113}$ or 50.7 per cent of the heat, costing

$$(80)\ (0.507) = 40.5\text{c. per } 1{,}000 \text{ lb.}$$

4. *Basis of Outside Cost*—In case it is possible to purchase exhaust steam from a nearby power plant, a definite basis of comparison may be used. If we take the price charged by the power company and deduct its net profit plus the cost of service, we arrive at a figure for the cost of exhaust steam which must be met by the consumer. Another factor, an intangible one, is the convenience of having control over the source of power and the amount available for peak load conditions.

In suggesting the foregoing bases for the evaluation of exhaust steam, it is realized that the same basis is not applicable to all plants. It is believed, however, that the factors of heat or power as used in the various unit operations forms a definite basis of calculation under nearly all conditions.

To Extract Oil From Coal

The extraction of oil from coal by the low-temperature carbonization process is the object of the installation of a plant at Nottingham, England, consular advices to the Department of Commerce state. The promoters expect to make Nottingham a smokeless city (the first in England), to furnish cheap gas and to reduce both waste and danger in the coal mines in addition to securing from 18,000 to 20,000 gal. of oil from every thousand tons of coal, which is the expected daily capacity of the plant.

Technology of Zirconium and Its Compounds

An Intimate, Authoritative View of the Significant and in Many Ways Unique Development of an Element That Exhibits Properties of Absorbing Interest to Many Industries

By Frederick C. Nonamaker
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JUST as legend is said never to create a personality but rather to adorn one having had real existence, so the rumors concerning the zirconium steel used by the Germans during the World War seem to have some foundation in fact, though highly colored and fanciful. After divesting the canard of its sensation, there seems to remain a modicum of truth that has served as a basis for the achievement of reliable scientific and technical advance.

The stories of impenetrable armor plate, of superior high-speed tool steel, of armor-piercing projectiles, of non-corrodible steel, all in some manner employing zirconium in their preparation—now as a purifying agent, again as an alloying metal—have served at least to awaken interest in an element that heretofore had been generally regarded as a chemical curiosity.

With the persistence and spread of the for the most part apocryphal accounts of the wonders of zirconium, the allied governments, wishing to overlook no opportunities more effectively to prosecute the war, began to encourage and foster investigation of zirconium with a view to its technical application in the manufacture of military and naval ordnance and equipment. The result was that private enterprise, either directly or indirectly at the behest of our government, began an intensive program of research upon practical methods of preparation of pure zirconium oxide. These efforts in the main were rewarded by success, but before the work had proceeded to the point of preparing and testing zirconium steels, the armistice was signed, bringing with it abandonment of the zirconium problem under government auspices. Lacking further support, the product of the war-time effort was forced to seek an outlet in peace-time industries and to capitalize as much as possible the interest created during the war.

In the minds of some there probably arises the question as to why, since zirconium was discovered more than a century ago, so little technical application had been made up to the time of the war. The answer is to be found first in the character of the only commercial mineral available, the silicate zircon, which is very inert to most reagents, decomposing only under very drastic treatment, as for example fusion with caustic soda at high temperatures. A second obstacle to the progress of commercial production of zirconium was the prohibitive cost of a reasonably pure product. Not infrequently there was to be found in the post-war technical literature articles deploring the lack of pure zirconium available for experimentation in the various industries in which its application had been suggested.

> Some day zirconium will play an important role in modern industry. The metal, once its commercial production is firmly established, promises revolutionary developments in the field of alloys—both ferrous and non-ferrous. The oxide, with a melting point of 2,900 deg. C., a coefficient of expansion of 0.00000084 low conductivity and exceptional resistance to chemical action, closely approaches the ideal refractory. The enamel industry is finding zirconia a likely substitute for the increasingly expensive tin oxide. These and many potential applications ably set forth in this article are convincing evidence that zirconium and its compounds stand on the threshold of a remarkable industrial development.

Further retarding the progress of the commercial work was the unscrupulous attempt of those more interested in profits than in achievement or service to exploit the popularity of the subject by placing upon the market, as pure zirconium compounds, very inferior, impure products. It was the experience of the writer to analyze a product advertised to contain well over 90 per cent zirconium oxide and find nearly 25 per cent of silica. How many interested investigators have thus been prejudiced against the use of the element or its compounds it is difficult to estimate.

Accomplishment rarely if ever can be said to be the result of isolated independent work, but rather the building by one worker upon the foundation laid by a predecessor, or on the other hand the collaboration and co-ordination of contemporary effort. To this rule the developments in the technology of zirconium are no exception, and the first important contribution to the commercial success of zirconium has been the discovery and opening of the Brazilian deposits of baddelyite, commercially known as zirkite. Occurring, according to Meyer (*Mineral Foote-Notes*, Nov. 29, 1916), in deposits of enormous extent in the Caldas region of Brazil, this mineral furnishes a commercial source of raw material from which zirconium and its compounds may be made without recourse to such drastic methods of decomposition as are necessary with zircon. Instead of a refractory silicate, zirkite makes available an ore that is preponderatingly oxide with an admixture of two silicates, zircon and brazilite. The color ranges from light gray to blue black and the specific gravity from 4.8 to 5.2. while the oxide content of the commercial ore varies from 75 to 85 per cent. Certain specimens, alluvial pebbles known as favas, contain from 90 to 95 per cent oxide.

The new mineral has the same crystalline form as the long-familiar zircon, but so far has furnished no gem forms corresponding to hyacinth, though both minerals are exceedingly hard. Meyer relates that the hardness of the zirkite is such as to preclude the drilling of holes for explosives and that the miners are compelled to resort to the methods of "pre-dynamite" days, heating the rock as hot as possible and producing a fracture by suddenly cooling with water.

Since zirkite contains about 50 per cent zirconium oxide as such, it will readily be seen that the problem of converting the zirconium of the ore into water-soluble form has been simplified. The oxide, while inert to most reagents, is attacked by both hydrofluoric acid and boiling concentrated sulphuric acid and in addition is more easily converted to sodium zirconate with a caustic soda fusion than is the oxide contained in zircon, where it is held in stable combination as a silicate.

Marden and Rich in Bureau of Mines Bulletin 186 give as the principal methods of decomposition for all zirconium minerals those employing fusion reactions as follows: pyrosulphate fusions, caustic, soda ash, sodium peroxide and sodium fluoride fusions; potassium and sodium acid fluoride fusions; "ignition with charcoal and subsequent chloridizing"; and electric furnace fusions with lime and carbon. This list is given with the proemial remark that though digestion with concentrated sulphuric acid at high temperatures and under pressure decomposes certain zirconium minerals, many authors prefer fusion methods. This preference had a very rational basis up to the time zirkite became available commercially. Now, however, the comparative ease with which concentrated sulphuric acid, at or near its boiling point under atmospheric pressure, converts the zirconium oxide of zirkite to a zirconium sulphate makes zirkite a raw material the exploitation of which is free from the difficulties and dangers of large-scale fusions.

Chemical Behavior of Zirconium

The exigencies of modern warfare having given to the study of the chemistry of zirconium a great stimulus, it remained for an unexpected scientific achievement to create new interest and impart a fresh impetus to the investigation of this fascinating but complicated subject.

On Jan. 20, 1923, Coster and Hevesy, of the University of Copenhagen, announced in *Nature* the discovery of a new element named by them "hafnium." This new element, discovered by means of the X-ray spectrum, was found associated with zirconium and to be very similar to zirconium in its chemistry.

Since no study of the chemistry of hafnium is possible without equal consideration of the collateral behavior of zirconium, the interest thus created, though of a purely academic nature, has nevertheless been reflected in the technical world by increased attention to the industrial application of zirconium and its compounds.

Certain chemical characteristics of zirconium and its compounds, thought until the advent of hafnium to be unique with zirconium, not only gave rise to the erroneous conclusions regarding its complexity but in addition were largely responsible for the prohibitive cost of zirconium compounds as well as for their bewildering tendency, like Proteus, continually to appear in some new and unexpected form. Most conspicuous among these properties is the hydrolysis of all the compounds in aqueous solution. Rodd (*J. Chem. Soc.*, 1917, vol. 111, pp. 396-407) is authority for the statement that no normal salt of zirconium exists in aqueous solution. This dissociation persists even in the presence of high concentrations of the acid, the anion of which is the same as that of the zirconium salt, as is illustrated by the stability of $ZrOCl_2$ in the presence of concentrated hydrochloric acid.

Hydrolysis is by no means confined to the soluble salts. Even the very stable phosphate after precipitation and complete washing continues to hydrolyze indefinitely with washing, each wash being slightly acid with phosphoric acid. The writer has also found the same type of hydrolysis very much in evidence when washing any of the many insoluble basic sulphates.

Again, in order to precipitate a compound of a given definite composition attention must be directed to control of the dilution of the zirconium salt as shown by the work of Venable and Smithy (*J. Am. Chem. Soc.*, 1919, vol. 41, pp. 1722-7), who precipitated the iodate from concentrated solutions of zirconyl chloride, $ZrOCl_2$, to obtain a precipitate which, with no washing, gave a ratio of ZrO_2 to IO_3 of 30.62 to 69.38, while precipitation of the same zirconyl chloride solution after dilution but otherwise under the same conditions produced an iodate analyzing ZrO_2 to IO_3, 33.14 to 66.86. Washing this second iodate with hot water changed the ratio of ZrO_2 to IO_3 to 55.38 to 44.62, illustrative of the common tendency of precipitated zirconium salts to hydrolyze.

A further hindrance encountered by the industrial worker in his efforts to produce pure zirconium salts is the marked adsorption evinced by many of the compounds, resulting in the formation of colloidal complexes in solution, making more involved the already complicated hydrolytic compounds. Adsorption also causes the precipitated zirconium salts to "drag down" with them dissolved salts from the mother liquors, thus often resulting in a very decided contamination. In the opinion of the writer, this accounts for the difficulty in separating zirconium from iron, aluminum and titanium by precipitation. According to Rodd polymerization in the hydroxide form is another of the peculiar chemical characteristics of zirconium with which the worker in this field must deal.

An important factor in the control of a reaction involving a zirconium solution is the previous history of such solution as shown by Rodd in his $Zr_4O_5Cl_6.22H_2O$ chloride made by dissolving in hydrochloric acid a hydroxide resulting from the ammonia conversion of insoluble basic sulphates, in contradistinction to the usual $ZrOCl_2.8H_2O$ formed in the hydrochloric acid solution of the precipitated hydroxide. The solution of the former gives an insoluble basic sulphate $Zr_4O_5(SO_4)_3.14H_2O$ upon addition of soluble sulphates, whereas the latter yields no precipitate under like conditions.

Separation and Purification

The hectic intensity of the war-time effort to produce cheap, pure zirconium led to the granting of many patents covering a great variety of methods, some of which are of doubtful efficacy.

Methods of purification employing the crystallization of the zirconyl chloride, $ZrOCl_2.8H_2O$, from acid solution, and also those based upon potassium fluozirconate, K_2ZrF_6, crystallization from hydrofluoric acid solution, have long been recommended, but apparently have not been commercially successful because of their expense.

The system zirconium oxide, sulphur trioxide and water, with its possible multifarious combinations and permutations, presented a pregnant source of new methods. Indeed so numerous are the compounds formed

and so frequent the unexpected appearance of the precipitates where sulphates and chlorides of zirconium coexist that to look among the basic sulphates for a method of purification is the obvious step. Significant, however, of our uncertainty as to the chemistry of the formation of these sulphate bodies is the fact that in almost no instance do the patents give the reactions by which the patented salt is formed. In addition to polymerization of the hydroxide, hydrolysis of the salts and the formation of colloidal complexes, the presence of the sulphate radical in a solution further complicates the behavior of the zirconium by causing its appearance in the anion (see *Zeit. anorg. Chem.*, 1904, vol. 42, pp. 87-99). And most of the basic sulphate methods of purification, therefore, have perforce been empirically developed.

These methods might be divided into two classes: first, those in which a sulphate solution or chloride solution containing sulphates is gradually neutralized to accomplish a progress precipitation of the zirconium as basic sulphate of indeterminate composition (Rodd, *loc. cit.*); second, those in which the zirconium basic sulphate is precipitated in the presence of acid without neutralization, giving a product more or less definite in composition (U. S. Patent 1,316,104 to Edward J. Pugh). With each class of basic sulphate methods there is a serious difficulty that not every patentee seems to have succeeded in overcoming. The first frequently gives contaminated precipitates difficult to filter and the second gives an incomplete precipitation. With these defects eliminated, the basic sulphate precipitation becomes a practicable method of cheap production of zirconium oxide or other compounds. A method devised by Hauser (*Zeit. anorg. Chem.*, vol. 45, pp. 185-224, 1905, and vol. 54, pp. 197-216, 1907) and verified by Marden and Rich employs the crystallization of a basic sulphate $4ZrO_2.3SO_3.14H_2O$ to separate zirconium from the naturally associated impurities of zirkite.

As with some of the other elements the compounds of which are strongly hydrolyzed, zirconium is precipitated from its weakly acid solutions by means of an excess of sodium thiosulphate. This reaction has been frequently used as a means of purification, although not generally used commercially because of the expense. Purification is, in general, less complete than with the basic sulphate methods.

Since zirconium gives an insoluble phosphate in the presence of mineral acids, it should obviously separate the element from most of its associated impurities in solution. This it does, but with the disadvantage that the phosphate is such a stable compound that it will yield the oxide only after fusion with caustic soda; also the phosphate precipitate is of such physical structure as to be exceedingly difficult to filter and wash commercially.

Electric furnace methods of purification have been patented and more or less successfully produce commercial grades at reasonable prices.

Further progress in methods of purification awaits elucidation of the chemical character of the element in aqueous solution, a work in which the colloid chemist is destined to have no small share.

Technical Applications

The investigation and determination of the properties and consequently the industrial applications of zirconium metal have been either arrested or vitiated by the complexities and peculiarities of the element, contributory to which are the facts of the next paragraph as told by Venable.

> The preparation of metallic zirconium presents many difficulties, and numerous attempts during nearly a century failed to produce the metal reasonably free from impurities. Some of the chief obstacles arise from its strong affinity for oxygen, and hence the difficulty of reducing the oxide and the ease with which the metal is reoxidized at high temperatures; also the readiness with which it absorbs and combines with hydrogen, nitrogen, boron and silicon and its tendency to form alloys with the light metals such as aluminum and magnesium.

So great are the error and confusion concerning zirconium metal that up to the present no general agreement seems to have been reached as to the number of possible varieties of the element. Four different forms —viz., amorphous, crystalline, graphitoidal and sintered —are mentioned and described by different investigators. Some authors hold that there exists but the amorphous form and that what has appeared to be a different variety of the metal is either the amorphous form contaminated with oxide or an alloy of zirconium with some other metal such as magnesium or aluminum.

The black amorphous pulverulent form of the metal when melted gives a steel-gray product capable of taking a high polish. The specific gravity determinations range from 4 08 to 6.4, the latter being considered by Venable ("Zirconium and Its Compounds," A.C.S. monograph) to be the most reliable value available. Melting point determinations have likewise fluctuated over a wide range, the minimum being somewhat above 1,600 deg. C. and the maximum 2,350 deg. C. The uncertainty characterizing these values prevails quite generally throughout the literature dealing with the constants of the element and is indicative of the disadvantages at which investigators attempting to make practical applications must work.

The metal is usually prepared by reduction of the potassium double fluoride $2KF.ZrF_4$ by metallic potassium, reduction of the oxide by metallic calcium, aluminothermite reduction and by treatment of potassium fluozirconate, K_2ZrF_6, with metallic aluminum. Since all these reactions take place at high temperatures, the necessity of performing the reduction in a vacuum is obvious.

Perhaps the first practical purpose for which zirconium compounds were produced was for manufacture of incandescent gas mantles, which were composed of a substantial proportion of zirconium oxide. Zirconia for this purpose, however, was superseded by thorium oxide, superior to zirconium oxide both in ease of preparation and as a light source.

With a very pronounced chemical activity, it is to be expected that zirconium metal as soon as available for experiment would be tried as a scavenger in steel making, and as a result of these attempts many patents have been issued covering its use in this industry, also covering the manufacture of ferrozirconium, in which form it is introduced into the steel. A large proportion of the patents pertain to the use of zirconium metal in production of an alloy zirconium steel having certain desirable properties.

Should the future bring forth a cheap method for the commercial preparation of the pure metal, there is every reason to expect some important development in the field of alloys, both ferrous and non-ferrous. Typical of some of these special alloys, the unique combinations of properties of which would make them particularly useful, are an alloy consisting of 65 per cent zirconium, 26

per cent iron, 7.7 per cent aluminum and 0.12 per cent titanium, said to be resistant to reagents, quite malleable and to be suited to manufacture of incandescent lamp filaments; "cooperite," an alloy of zirconium and nickel free from iron and carbon, and claimed to be superior as a high-speed tool metal; alloys of the aluminum-zirconium class, the best known perhaps being that represented by the formula Zr_3Al_4 and characterized by a definite crystalline structure, resistance to reagents and oxidation at high temperatures, and by glass-scratching hardness; and last of all, the zirconium steels already mentioned.

The alloys with aluminum are said to possess the property of selective radiation, making them efficient light sources when heated to incandescence and suggesting, by their employment in manufacture of lamp filaments, an increase of efficiency of the incandescent electric light.

Since zirconium metal readily reacts with nitrogen to form a nitride, which in turn, when treated with water, produces ammonia, it is of interest to speculate upon the possibilities of using the metal in the fixation of nitrogen. Cheaply available zirconium might revolutionize the entire nitrogen fixation industry.

The Oxide as a Refractory

With an element of such marked chemical activity, forming compounds as inert and stable as those of zirconium, the obvious and logical step in the application of the element or its compounds is to attempt the use of the compounds as refractories. The oxide, having a melting point of about 2,900 deg. C., coefficient of expansion of 0.00000084 and very low conductivity, in addition to an almost unparalleled inertness to chemical action, suggests itself as an excellent material for furnace linings and crucibles.

The most extensive use of zirconia as a refractory is probably its employment in the form of crude zirkite, either as bricks or a mortar for blast-furnace linings and the like.

In the linings of small furnaces and in vessels for high-temperature reactions a rather pure (95 per cent to 99 per cent ZrO_2) zirconium oxide promises to find a place the extent of which will largely depend upon cheapness of a suitable oxide. Freedom from slagging, breakage or melting at high temperatures admirably adapts zirconia vessels to metallurgical work of a very exacting character and heretofore almost impossible.

The stability of zirconium oxide under such a great variety of conditions has led to many suggestions as to its use as an opacifier, replacing tin oxide, in vitreous enamels, and around no other application of zirconium and its compounds does so must interest center at present. The tendency of late for the price of tin oxide to climb, with prospect of continued increase, has caused enamelers to look to zirconia to supply an opacifier at a comparatively stable price. And from this standpoint the prospects for zirconia are improving, since the price of zirconia tends to recede.

The introduction of zirconium oxide into the enamel industry has, however, been attended by other serious difficulties. For several years the more progressive enamelers have been attempting to replace tin oxide with zirconia, but have met with frequent failure because the substitution was often made in formulas without any other changes to take into account the difference between the chemical behavior of the two oxides. In other words, it should have been remembered that an enamel formula giving satisfactory results with tin oxide might be very poor with zirconia and vice versa. These facts operated very strongly to retard this development, particularly since the enameler, who is nothing if not conservative, was often loath to make any changes in a formula that was known to be giving good results.

Of especial interest and importance in this connection is the work of Wolfram (*J. Am. Cer. Soc.*, 1924, vol. 7, pp. 1-13), which shows that zirconium oxide can replace tin oxide weight for weight as an opacifier and in addition impart to the enamel increased strength and higher resistance to thermal shock and to the action of acids. A pertinent comment found in Wolfram's summary reads: "A further field of investigation could be suggested in which the composition of the enamel and combinations of ground and cover coats could be worked out to give very satisfactory results."

Another factor apparently of no little importance is that of physical structure of the opacifying zirconia, the indications being that a high degree of comminution is in itself not sufficient. It would seem that certain inherent physical characteristics are also requisites. Attempts have been made, with more or less success, to introduce as opacifiers the borate, phosphate and silicate.

Enamelers in increasing numbers are interesting themselves in zirconia in their efforts to replace the increasingly expensive tin oxide, all of which augurs well for the future of zirconia in this industry. Some investigation has been directed toward use of zirconia as a clouding agent in glass manufacture, but zirconia seems so far to have little advantage over the products already in use.

Zirconia, being dense and pure white, gave some promise of finding use as a pigment in the paint industry, but its cost is still so much greater than that of the pigments of equal covering power already in use that little progress has been made in this direction.

Other uses suggested for the oxide of zirconium are in manufacture of abrasives, particularly the carbide, which is said to be a good substitute for the diamond in glass cutting, and as a substitute for bismuth salts in X-ray photography. The oxide has also been used as a filler in manufacture of rubber goods.

Application of Other Compounds

Salts of zirconium have been employed to replace those of aluminum, chromium or iron as mordants and in some cases with decided improvement. The cost of zirconium salts has undoubtedly been a bar to progress in this field.

The acetate has been employed in the weighting of silk, but results so far do not justify a substitution of this salt for stannic chloride, although the use of zirconium acetate would not be attended by the tendering action upon the silk that often results from the free hydrochloric acid of the tin bath.

The tungstate and stannate have had some attention as materials for fireproofing textiles.

One of the outstanding and in some respects unique properties of zirconium and its compounds is its colloidal behavior, yet most of the attempts at commercial application have been along lines where the use of other substances was already quite well established and where the zirconium compound, for a long time at least, possessed no very conspicuous advantage.

In the role of a colloid, however, zirconium compounds

evince some unique properties that may ultimately fit them for an important place in industry.

The hydroxide as an adsorptive agent in purification of water has received mention in the literature. This property of adsorption is possessed to a very marked degree by many of the precipitated zirconium salts, and its application to industry, in the opinion of the writer, is fraught with many possibilities.

Further peculiarity of behavior is to be seen in the acetate, which seems to be a hydrophilic colloid. It is soluble in water in all proportions, can be salted from its aqueous solutions like soap, and when shaken the solution lathers quite freely. Evaporation of the solution causes no crystallization, but results in an amorphous mass resembling gelatine. Solution of the residue from this evaporation takes place very much after the manner of the solution of gelatine, with first a swelling and softening and then a gradual dissemination of this gel through the liquid. It is in the exploitation of these peculiar properties of the zirconium compounds that the most important industrial applications may yet be found.

An accomplishment often has its inception in a suggestion. If this article, written from the standpoint of the technical worker, has by any of its suggestions aroused or quickened the interest of any of its readers in the technology of this most interesting element, its purpose shall have been served.

A Picture of an Industrial Giant

Ingenious Exhibit of the Nobel Industries at the British Empire Exhibition Tells Its Amazing Story to the Public With Remarkable Models

BY COMMON consent Section E of the Palace of Industry in the Empire Exhibition (London, England) has been acknowledged one of the most interesting of the numerous trade sections into which this huge building is divided. Directly adjoining the Chemical Section, it is entirely devoted to a display of products of the Nobel industries—a co-operative organization formed in 1918 by the amalgamation of thirty-four manufacturers of explosives and accessories, ammunition, chemicals, metals and allied industries.

The exhibits in the section embrace numerous types of explosives and gunpowders used for industrial purposes; propellent and disruptive explosives, brass cartridge cases, fuses for shells, small arms ammunition, sporting cartridges, metal products, both raw and semi-fabricated, with examples of the physical tests imposed on them; nails, gas mantles, new collodion products in the form of paints and varnishes, motorcycles and ordinary bicycles, radiators, carburetors, automobile accessories, welding plant, leather cloth for all kinds of upholstery purposes, samples of fertilizers, a variety of chemical and other products too numerous to mention.

In their display the exhibiting firms have endeavored to disprove the popular fallacy that the explosives industry is dependent upon war for its prosperity, by demonstrating that the manufacture of explosives for industrial purposes at a low price is one of the fundamental necessities of modern progress and that factories for the production of industrial explosives form the nucleus for the manufacture of munitions of war in a national emergency. This, they claim, represents the true relation of the industry to warlike purposes. The importance of explosives in the development of industry will be appreciated from the fact that in winning coal and metal ores from British mines alone 50,000 tons of explosives, with the requisite blasting accessories—detonators, safety fuse, etc.—manufactured by the companies associated in this combine are used annually. Visitors can observe the relationship between the metal and the explosives sections of this undertaking, especially in the apparently insignificant but really important detonator, and also in sporting cartridges for shotguns, rifles, revolvers and containers of greater caliber for explosive charges.

It is also clearly shown that mining does not exhaust the industrial application of explosives. Their destructive properties for constructive purposes are adequately represented in engineering projects, such as cutting tunnels, building roads and railways and removing obstructions to navigation, by a model landscape, photograph of a part of it being reproduced herewith. This huge model can be justly described as a work of art, since for months women artists have labored on it. It is a feature of the industrial division of the exhibition.

The Nobel Model

This is considered the most outstanding exhibit in the Chemical Section of the British Empire Exhibition. It shows the work of some of the associated companies, including a railway and a colliery.

Equipment News

From Maker and User

Temperature Controller for Gas-Fired Furnaces

For many reasons the use of gas as an industrial fuel has been increasing enormously of late years. One of the incidental advantages flowing from this trend is the ease with which a gas-heated furnace may be regulated. This has led to the design of several devices for the automatic temperature control of gas-fired equipment. One of the most recent to attract notice is the McKee Temperature Controller, marketed by the Eclipse Fuel Engineering Co., Rockford, Ill.

In controlling temperatures two elements are necessary—one an instrument responsive to temperature changes and the other a regulating unit that makes the necessary mechanical adjustment of the fuel supply. The McKee controller is a regulating unit that controls the fuel supply in response to the action of a temperature-measuring instrument. It is made in two types, series "A" to regulate temperatures in equipment with blast burners handled by a single valve control device and series "B" for use with equipment having atmospheric or natural draft burners, high-pressure gas burners, or blast burners handled by a single valve control unit such as the McKee proportional mixer for low-pressure air.

The series "A" controller is shown in Fig. 1. It consists of a solenoid with special exhaust valve inclosed in an aluminum case and a governor with copper tube connection from the lower chamber to the exhaust valve below the solenoid. At the top of the governor is a bypass adjustment that regulates the amount of turndown

Fig. 1—Series "A" Temperature Controller

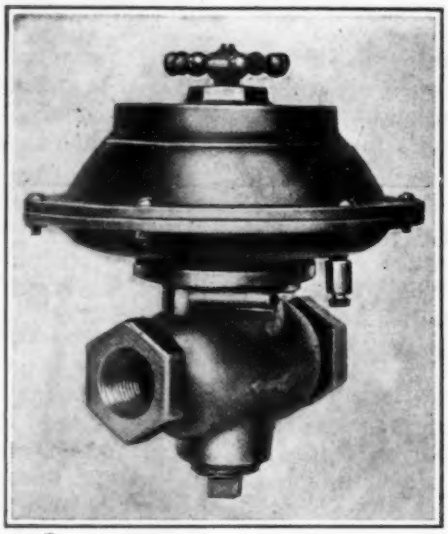


Fig. 2—Series "B" Temperature Controller

when the action of the controller cuts down the fuel supply.

This device is designed to operate in conjunction with a Leeds & Northrup temperature-measuring instrument. This makes and breaks contact in an electric circuit according as the temperature is below or has reached the limit set. The McKee controller is placed in the air line. Whenever the temperature is below the desired limit, current is passing through the solenoid and the exhaust valve is open. In this condition, the main valve below the governor is wide open and the burners are on full. As soon as the desired temperature is reached, action of the temperature-measuring instrument breaks the contact in the solenoid circuit. A weight on the core in the solenoid drops and closes the exhaust valve. Instead of bleeding to the atmosphere, the small amount of air from the valve passes through the cross-connection to the lower chamber of the governor. The pressure thus created in this chamber raises the diaphragm and closes down the air supply, which in turn proportionately closes off the gas. The bypass adjustment at the top of the governor prevents the main valve from closing entirely—the amount of turn-down being quickly and easily regulated. The controller is so constructed that snap action of the valve in closing is eliminated, gradual closing preventing any possibility of back firing.

The series "B" controller is shown in Fig. 2. This controller is designed to operate with any type of pilot thermostat. The thermostat is placed in the chamber or medium to be heated. The controller is placed in the fuel line when low- or high-pressure gas is used and in the air line when used with the McKee proportional mixer for low-pressure air. The threaded pipe on the side of the controller is connected to the inlet opening on the head of the thermostat. As long as the temperature is below the desired point, the small amount of exhaust gas or air, as the case may be, passes freely through the head of the thermostat. When the required temperature is reached, the valve in the thermostat head automatically closes and the exhaust accumulates below the diaphragm in the lower chamber of the governor—creating a pressure that raises the diaphragm and closes the main valve.

When the temperature drops below the point at which it is desired to hold it, the valve in the head of the thermostat opens and the exhaust once more passes freely through the head of the thermostat. The pressure below the diaphragm in the governor is relieved and the main valve opens, permitting more gas to pass to the burners and raising the temperature. The amount of turn-down is easily adjusted by regulating the valve wheel at the top of the governor.

Steel-Clad Transformers

The Westinghouse Electric & Manufacturing Co. has recently applied the sheet-metal case construction to its distribution transformers of 6,900, 11,500 and 13,800-volt rating. Hitherto the sheet-metal construction of transformer cases was limited to distribution transformers for 2,300-volt service.

The material selected for the tanks is a special grade of steel that can be readily drawn and welded and that possesses inherent rust- resisting qualities. The parts for the cases are stamped out by large presses, and are welded together to form the complete tank. To make the outside of the case weatherproof, it is first shot-blasted to remove the scale and dirt and to clean and roughen the surface. A coat of priming paint is then applied and baked on. To protect this first coat, a finishing paint heavy in oil is applied and baked on. This process gives a reliable weatherproof surface, as well as a smooth and attractive exterior finish.

The substitution of the sheet-metal parts for the cumbersome cast-iron parts formerly used effects a great reduction in weight and physical dimensions and at the same time increases the strength and ruggedness of the transformer. Consequently, the difficulty of installing this type of transformer on line poles is very much lessened, and the strain on the pole and cross-arms caused by the heavier cast-iron apparatus is eliminated to a great extent.

The electrical details of the transformer have also been improved, thereby increasing the efficiency and reducing the iron and copper losses. Larger

porcelain bushings have been used, and greater insulation clearances have been allowed.

10-Ton Crawling Tractor Crane

The Industrial Works, Bay City, Mich., which recently designed and built several 200-ton locomotive cranes that were the largest in the world, now offers a new type at the other end of the scale. This is a 10-ton crawling tractor crane embodying many new engineering features and known as type "D."

One of the most important features is the independent control of the traveling, slewing and hoisting motions. These motions may be utilized in a variety of combinations, which are said to result in a greatly increased speed and efficiency of operation. For instance, the hoisting and slewing motions may be combined in bucket work for operation at high speed, and when traveling, the boom may be swung in any direction to clear obstructions. Slewing in either direction is accomplished without reversing the engine by means of a double friction clutch and a train of bevel and spur gears. A slewing brake holds the boom securely with a suspended load in any position. When operating on uneven ground, this brake eliminates any possibility of sudden rotation with its usual disastrous results. The vertical slewing shaft is located accessibly at the front of the crane close to the base of the boom, and since the power is transmitted at this point, there is no great slewing stress through the revolving frame.

The entire upper works rests on a rotating steel base, which insures rigidity and alignment. This base rotates on four conical steel rollers, which are easily accessible and which may be taken out without removing any of the parts or jacking up the crane. Heavy steel side frames that carry the shaft bearings are bolted to this rotating bed. These bearings are arranged on the outside of the frames so that any shaft may be easily removed without displacement of other parts. All running bearings are provided with replaceable bronze bushings. Wearing surfaces of all thrust bearings are separated by bronze washers, and bronze collars are placed behind each bevel gear. All gears in the upper works are of cut steel. All oil pipes lead to the operator's platform and the lubrication is accomplished by a pressure system. Clutches controlling the various motions are of a new friction type, which are said to engage smoothly and without shock.

Tractor shoes are close-fitting, smooth surface steel and they operate over adjustable idle sprocket bearings, which take up the slack in the tractor belt. Five large-size rollers of 25-in. diameter on each side decrease traveling friction and keep the bearings high up out of the dirt. The steel bed plate mounted on the car body is cast integral steel with a circular roller path and external slewing rack. A steel hollow center post is pressed under heavy pressure into this baseplate, for the superstructure.

Ten-Ton Crawling Tractor Crane

The crane has two traveling speeds, and reversal of direction is accomplished by reversing the engine. Steering while propelling is accurately accomplished from the operator's platform through friction clutches and brakes controlling each tractor belt. Either belt may drive, coast or be held by brake in any degree to negotiate as sharp or wide a turn as desired. This propelling and steering mechanism is one of the exclusive features of this type "D" crane. It enables the operator to propel and steer the crane independently of all other motions with the boom in any direction. It is especially powerful, enabling the crane to travel up steep grades and over rough ground. Propelling up an inclined skidway onto a flat car for transportation is very easily done. Other exclusive features are the automatic double hoisting drums, which provide automatic control of the bucket during operation. Both drums provide enough rope pull as required for dragline and hoisting purposes. The feature of hoisting the bucket open on the auxiliary drum greatly increases the output of the crane and makes operation much simpler. A radius-varying appliance consisting of bronze worm, wormwheel and drum and controlled by friction clutches and semi-automatic brake raises or lowers the boom when loaded to its maximum capacity. Levers actuating all motions are conveniently placed in two rows in front and alongside of the operator's platform, which is located on the right-hand side with a full view of the work being done.

This new Industrial crane is built for steam, electric or gasoline power. The steam crane has two horizontal, double acting cylinders 6 in. diameter by 8 in. stroke. The engine is equipped with a simple radial type reversing gear, by means of which loads may be lowered and the hoisting line paid out by power. Cylinder and crosshead guides are cast in one piece and bored at the same setting, thus insuring accurate and permanent alignment. The gasoline crane is equipped with the "Buda," Climax, Wellman-Seaver-Morgan or Automatic semi-Diesel engine at the option of the purchaser.

The crane is extremely versatile, operating with clamshell or dragline bucket, electromagnet, hook and block or grapple. It is readily convertible into a shovel or a pile driver. The makers are confident that their new crane will supply a demand for a general utility crane of small capacity sturdily built. It should find a ready market in many fields of industry.

Manufacturers' Latest Publications

Sullivan Machinery Co., Chicago, Ill.—Bulletin 71-H. A new catalog of the Sullivan air lift pumping system. This catalog discusses several installations of this type of equipment that are typical of the different conditions encountered and also gives a full illustrated description of various other installations. In addition, specifications and engineering data are included.

Wagner Electric Corp., St. Louis, Mo.—A folder on the relation between the electrical industry and agriculture.

Euclid Crane & Hoist Co., Euclid, Ohio.—A catalog entitled "Euclid Utility," describing various industrial uses of the Euclid line of motor-driven hoists and monorail cranes.

Superheater Co., 17 East 42nd St., New York City.—A booklet describing the origin, development and results obtained by the use of the Elesco type of superheater in various types of industrial plants, including those used in connection with furnaces, kilns, petroleum stills, etc.

Kuhlman Electric Co., Bay City, Mich.—A catalog of series multiple street lighting transformers.

M. A. Hofft Co., 814 W. Washington Ave., Indianapolis, Ind.—A new catalog describing in detail the "National" type of furnace arches for use in industrial and boiler furnaces.

Conveyors Corporation of America, 326 W. Madison St., Chicago, Ill.—A booklet describing cast-iron storage tanks of the sectional type for the storage of dry, loose, bulky material such as ashes, coal, sand, gravel, etc.

Cambridge & Paul Instrument Co., of America, Inc., Grand Central Terminal, New York City.—Booklet 1. A catalog of the "Cambridge" type of temperature-measuring instruments.

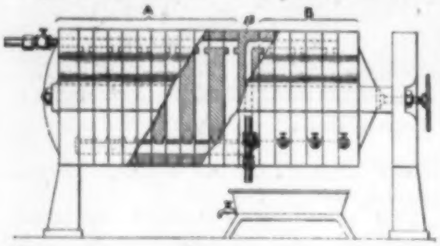
Crouse-Hinds Co., Syracuse, N. Y.—Bulletin 2058. A booklet on the "Wedgtite" pipe hanger, a device for supporting pipe from floor or ceiling beams in industrial plants.

Thermo Electric Instrument Co., 14 Johnson St., Newark, N. J.—A folder describing the Freas aging oven No. 109-A for use in the testing laboratory of the rubber factory.

Review of Recent Patents

Filtering Twice in Same Press

There are many materials, especially those of a colloidal nature, which it is not possible to completely filter or clarify in a single passage through the usual filter press, when working at a normal and economical rate of filtration. Using a number of cloths between the frames and plates of the press only slightly improves clarification, while filtration is impeded to a very marked degree, making it an uneconomical and in some cases an impracticable pro-



Filter Press

cedure. This difficulty is usually overcome by filtering the liquid twice, first through one press to remove most of the solids, and then through a second press to secure clarification. This practice of filtering by two separate presses is, however, subject to various objections, such as complication of apparatus, and so forth.

Charles C. Ahlum, of Chester, Pa., has developed a method of press construction that permits the two filtrations to be made in the same press. As shown, the press consists of two plate-and-frame sections *A* and *B*. Separating these is a special plate 15, having an internal channel through which the filtrate from section *A* enters the feed port of section *B*. (1,498,313, assigned to E. I. du Pont de Nemours & Co., Wilmington, Del., June 17, 1924.)

Recovering Sulphur Trioxide

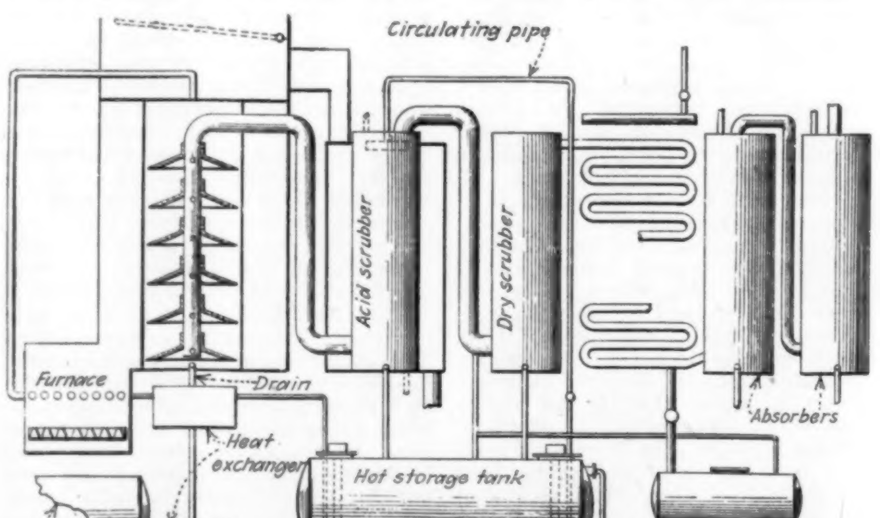
In practice no attempt is made at direct condensation of sulphur trioxide and the gases are scrubbed with concentrated sulphuric acid in which the trioxide dissolves, producing fuming acid or oleum; an acid containing a greater ratio of SO_3 to H_2O than corresponds to the 1 : 1 ratio of sulphuric acid, H_2SO_4. Ordinarily acids stronger in SO_3 than would correspond to an acid of about 112.5 per cent equivalent H_2SO_4 cannot be readily produced in regular operation by direct absorption in the contact process. Acids of a higher content of SO_3 are, however, desirable for various purposes; SO_3 itself is also desirable commercially. Although sulphur trioxide is volatile, recovery by distillation presents many difficulties.

Norman C. Hill, of St. Louis, Mo., has developed a method of continuous distillation in which heating of the acid and distillation or vaporization of the trioxide from the hot acid are separately performed; the fuming acid being continuously passed through a tubular heating element as a flowing current and then into a special releasing or stripping element, where it is filmed out and freed of its volatiles. In so doing, the amount of acid to be heated is not great at any one time and there is a constant and uniform delivery of trioxide vapors. This uniformity of delivery is conducive to efficient work of the condensing means. Operating in this manner, an opportunity is afforded for a methodical utilization of heat by the use of heat-exchanging means, and this is done. After stripping the acid of its trioxide, the heat of the stripped acid is transferred to fresh acid to be distilled, the stripped acid being thereby cooled and adapted to serve anew as an absorbing means in a contact plant. Some of it may be used as absorbing means in the final absorbing means of a condensing and absorbing train hereinafter described. The trioxide vapors are usually very hot and carry as entrained mist or vapor and should be somewhat cooled and be freed of this acid to permit condensation of trioxide as such. The excess heat may be, and advantageously is, transferred to the acid to be distilled. The cooled and purified trioxide vapors are condensed, or are absorbed in sulphuric acid as the case may be. The vapors carry no substantial amount of air or diluting gas, and condensation or absorption of the SO_3 can be readily accomplished. Sulphur trioxide vapors, free of sulphuric acid, on cooling somewhat, give a liquid condensate of trioxide. Further cooling, or the presence of traces of H_2SO_4, leads to polymerization and to the formation of a crystallized solid product. Formation of this solid product is not here desirable since it may lead to a stoppage. At the temperature of formation of liquid SO_3, the SO_3 has still a considerable vapor tension; that is, some SO_3 is condensed as a liquid and some SO_3 vapor tends to pass beyond a condenser held at the temperature where formation of liquid SO_3 occurs. It is therefore commonly desirable to provide beyond the condensing means suitable absorption means for recovering this vapor. These absorption means may be supplied with acid from the system hereinafter described, or with contact acid to be strengthened. Usually it is desirable to have at least two absorbers, the last one in series being fed with ordinary 98 to 99.8 per cent sulphuric acid; this concentration of acid being best suited for absorption. (1,498,168, June 17, 1924.)

Grinding Smokeless Powder

Smokeless powder deteriorates with age and becomes unfit for military purposes. It may, however, be converted into a useful form for explosive and other purposes by comminuting the grains, that is, reducing them to a finely divided or powdered condition. Heretofore, this has been customarily accomplished by grinding, or crushing and grinding the grains of powder without preliminary softening. Because of the hard, tough and horny nature of the grains, the comminution has required a great deal of power and consequent expense. In addition the comminution has involved an explosive and fire hazard even when conducted under water.

Gerald H. Mains, of Detroit, Mich., and Fred B. Stieg, of Chevy Chase, Md., have found that by immersing the grains of nitrocellulose powder in a treating solution composed of furfural, ethyl alcohol and water in certain proportions a softening action is exerted on the grains, which swell and absorb furfural, alcohol and water, but do not become gelatinous or sticky. When the powder has become entirely softened throughout, it may be readily disintegrated by almost any of the well-known grinding processes, ball mill treatment or treatment in a beater. The disintegrated powder is freed from the absorbed solvents by washing with water. The powder may then be dried



Recovering Sulphur Trioxide

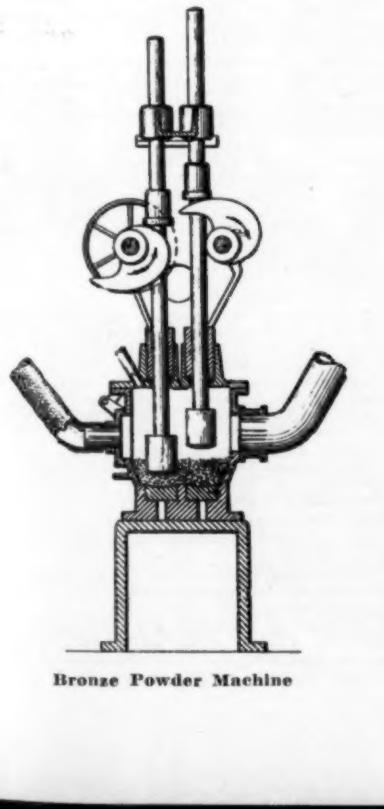
by the usual processes. The dried powder is in a very fine uniform condition and may be used in various ways, for example (1) to make up new sizes of smokeless powders by gelatinization with a suitable agent (2) alone or mixed with other ingredients to form blasting and explosive powders, or (3) to serve as a base for lacquers and varnishes, and for artificial leather and similar products.

As an example, the method as applied to the large cylinders of smokeless powder used for 15-in. guns is to place 2.6 kg. of the powder in a small tank with 3.8 liters of technical furfural and 14 liters of 95 per cent (by volume) ethyl alcohol. The grains are allowed to soak for about 20 days at room temperature, when the grains are softened throughout. The liquid and powder are placed in a ball mill and the mill stopped when a sample shows a fine enough state of subdivision. The excess treating solution is decanted, and the powder stirred into 50 liters of water. The liquid is decanted from the powder and 25 liters of hot water added. The powder is then drained and dried. (1,498,053, June 17, 1924.)

Bronze Powder

In making bronze powder by hammering the metal to reduce it to small particles, it is important that the finished fine powder be accurately separated from the larger unfinished particles. Particles overtreated also tend to become granular, losing their brilliancy and flaky structure.

Claude A. Bulkeley, of Wilmington, Del., uses the combined agencies of air-separation and screening to accomplish the desired results. Coarse bronze powder is fed at intervals to the reducing machine, of the type commonly called a "sixteener machine," where it is reduced to powder by the action of the hammers. Reduced material is picked up by an air current passing over the surface of the powder and carried to a cyclone separator. The powder that separates goes to a revolving screen covered with 200-mesh silk bolting cloth. Powder passing through the screen forms the finished product, the oversize being returned to the reducing machine. (1,498,318, assigned to E. I. du Pont de Nemours & Co., June 17, 1924.)



Bronze Powder Machine

Rubber Emulsion

Rubber may be emulsified according to a method suggested by Lester Kirschbraun, of Chicago, as follows: Bentonite, 20 per cent, rubber, 80 per cent, and 60 parts water are used. The water and bentonite are first mixed together and the rubber is then added in such form as may be desired. The mixture is heated to 300 to 400 deg. F., with 50 to 200 lb. pressure and thoroughly agitated to form the emulsion. As this is miscible with water, it may be diluted as desired for various purposes. (1,498,387, June 17, 1924.)

Readers' Views

Electric Motors for Driving Centrifugal Water Pumps

To the Editor of Chem. & Met.:

Sir—We have given careful attention to the article by Erik G. Sohlberg on the subject of electric motors for driving centrifugal water pumps, which appeared on page 832 of your issue of May 26.

As builders of steam-driven reciprocating pumping machinery and steam turbine and electric motor-driven centrifugal pumps for water works and other service, we are most desirous of having comparisons made of these different types of machines on a basis that will not lead to unsound conclusions from either claiming advantages for one type that it does not possess or from charging disadvantages unjustly to another type. We regard it as unfortunate, therefore, that Mr. Sohlberg has drawn conclusions from data and statements that are unsound for both of the foregoing reasons. In addition, we believe it is unfortunate that he should have used, as a basis for his comparisons, modern machinery for one type and obsolete machinery for the other type, as has been done in comparing the centrifugal and reciprocating pumping machines in the article.

There are very serious and, we believe, unjust basic assumptions made in comparing the heat consumption and economy of existing central station electric generating plants and existing water-works plants. This may be an understandable error in that engineers in other branches of work are not generally conversant with the very excellent economy that is maintained by water-works engineers in their steam stations. It is perhaps not generally realized that the modern crank and flywheel pumping engine will very frequently exceed the efficiency of the more ordinary sizes of central station steam turbo-generators. For this reason it is our opinion that 950,000 ft.-lb. output of pumps per pound of coal is not a representative figure for modern stations. Many instances of existing plants can be cited where this figure is exceeded more than 10 per cent by stations operating with low initial steam pressures. These figures, of course, include all steam consumed in the plant for all purposes of heating and generating current for light and power around the stations.

The relative charges for maintenance for different types are on an unsound basis, probably as a result of lack of information as to the proper maintenance charges for existing water-works pumping plants using crank and flywheel steam prime movers. It can be very readily shown from authoritative data in existing plants with crank and flywheel pumps that maintenance charges are usually less than 1 per cent of the first cost on the main units.

We wish further to point out that the tabulation showing the cost of pumping water with the various types is in error, since it seems to show that a smaller boiler plant and smaller fuel consumption are required with the steam turbine-driven centrifugal pumping units than with the reciprocating type. It is well known that the modern crank and flywheel pumping engine will require from 20 to 25 per cent less steam per delivered horsepower than the steam turbine-driven centrifugal pump of similar size and operating under the same steam conditions.

In addition, the article further predicates all advantages of the electric system of pumping on the feature of remote control and on the addition of a reservoir to the system. As builders of all types of machinery compared in this article, we are convinced that the remote control feature in a city water supply will not increase the continuity of service that has been the pride of the water-works engineer in every community of the country. Also, if a reservoir is necessary to preserve this continuity, most certainly at least a portion of the cost of this equipment should be charged to the electric method of pumping, for it is demonstrated by existing equipment in a very great number of cases that reciprocating steam engines and, to a lesser extent, turbo-centrifugals, supply the necessary flexibility and reliability lacking in the synchronous motor-driven pump, which allows them to jump directly into the mains without the use of a reservoir.

There are other points given in the article that are open to question, but our letter has already extended beyond our intentions. Therefore, in conclusion, allow us to say it is not our intention to decry or minimize any of the great advantages of the electric-driven centrifugal pump in the many cases for which it has special adaptability. We do, however, feel that such extremely general statements as are made in the article under consideration are unwarranted by the present development of the science of pumping water, and that each case should be studied on its merits by engineers possessing a sufficient fund of information to enable them to make an unbiased comparison and thus arrive at the best method, always remembering

that continuity of service is probably more important in municipal water supply than any other necessity of our modern civilization and that this requirement must, therefore, be a major determining factor in such a selection.

ALLIS-CHALMERS MFG. CO.,
M. C. SHAW,
Engineer, Pumping Engine Department.
Milwaukee, Wis.

Books Received

Electric Furnace Refractories

REFRACTORIES FOR ELECTRIC FURNACES. Second edition, 94 pages. Published by the American Electrochemical Society, Columbia University, New York. Price, $1.

The original edition of this book was a report of the proceedings of the Electric Furnace Association and included papers presented at one of its meetings together with stenographic record of the discussion. Additional papers, specially prepared, have been included in the present edition, which now contains discussions on the whole field by R. M. Howe, C. E. Williams, R. T. Stull, H. F. Staley, C. W. Berry, A. F. Greaves-Walker and the Norton Co. Aluminous refractories are treated by L. C. Hewitt; carborundum by M. L. Hartmann. An immense amount of practical information is thus made available in convenient form.

Executive Control

THE TECHNIQUE OF EXECUTIVE CONTROL. By *Erwin Haskell Schell*, Massachusetts Institute of Technology. 133 pages. McGraw-Hill Book Co., New York. Price, $1.75.

A thoughtful analysis of the executive personality and a constructive discussion of the qualities that aid in the successful control of men! The presentation is somewhat novel, as it teaches by the now well-known "case method," suggesting a problem that an executive might have to handle and that would illustrate a specific point. The book is not dogmatic and in that single quality it shows that the author understands the problem of dealing with personalities.

New Publications

THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH has issued Technical Paper 9, Fuel Research Board, on "Carbonization of Seaweed," as a preliminary to the extraction of iodine and potassium salts. Prices 6d net. Copies can be obtained from H. M. Stationary Office, Princes Street, Westminster S.W.1, England.

NEW U. S. GEOLOGICAL SURVEY PUBLICATION: I: 29, Gold and Silver in 1922, by J. P. Dunlop (Mineral Resources of the U. S., 1922, Part I), published June 4, 1924.

NEW BUREAU OF MINES PUBLICATIONS: Bull. 227, Flame Safety Lamps, by J. W. Paul, L. I. Ilsley and E. J. Gleim; Bull. 214, Tests of Marine Boilers, by Henry Kreisinger, John Blizard, A. R. Mumford, B. J. Cross, W. R. Argyle and R. A. Sherman.

NEW UNIVERSITY OF ILLINOIS BULLETINS: Circular 11, The Oiling of Earth Roads, by Wilbur M. Wilson; Bull. 140, The Viscosities and Surface Tensions of the Soda-Lime-Silica Glasses at High Temperatures, by Edward W. Washburn, George Reed Shelton and Earl E. Libman.

U. S. Patents Issued July 15, 1924

These patents have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Process for Plating Stainless Steel and Articles Produced Thereby. Alexander Harper, Bristol, Conn.—1,501,049.

Water-Activated Reserve Cell. Raymond C. Benner, Bayside, and Harry H. Thompson, Flushing, N. Y., assignors, by mesne assignments, to National Carbon Company, Inc., New York, N. Y.—1,501,091.

Process of Calcining Carbon and Products Thereof. Victor C. Hamister, Cleveland, Ohio, assignor, by mesne assignments, to National Carbon Company, Inc., New York, N. Y.—1,501,108.

Production of Carbon. Alice Marion Hart, London, England, assignor, by mesne assignments, to Edmund R. Cummins, Worcester, Mass.—1,501,111.

Drying Apparatus for Pulverulent Material. Paul Scrive, Paris, France.—1,501,140.

Process of Manufacturing Alloy Steels in Electric Furnaces. Napoleon Petinot, New York, N. Y., assignor to United States Ferro-Alloy Corporation, New York, N. Y.—1,501,184.

Process and Apparatus for Treating Milk. Chris M. Peterson, Minneapolis, Minn.—1,501,182.

Method of Making Chromium Steel and Chromium Iron. Napeolon Petinot, New York, N. Y.—1,501,183.

Steel and Process for Producing Same. Archibald H. Coplan, Ottumwa, Ontario, Canada.—1,501,202.

Plastic Containing Cellulose Acetate. Henry Dreyfus, London, England.—1,501,-206.

Manufacture of Cellulose Derivatives. Henry Dreyfus, London, England.—1,501,-207.

Charging Valve or Door for Furnaces, Gas Producers, Retorts and Similar Structures. James H. Hardman, Pendleton, Salford, England.—1,501,216.

Ester of 6.8-Dimethyl-2-Phenylquinoline-4-Carboxylic Acid and Process of Producing the Same. Moses L. Crossley, Somerville, N. J., assignor to Calco Chemical Company, Boundbrook, N. J.—1,501,275.

Decolorizing Medium for Oils, Fats and Other Liquids and Process of Making Same. Wilhelm Eberlein, Ahrensburg, Germany, assignor, by mesne assignments, to The Chemical Foundation, Inc., Delaware.—1,501,321.

Apparatus for Surfacing Plate Glass. John H. Fox, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company.—1,501,327.

Machine for Sensitizing Papers and Other Fabrics. Benjamin James Hall, Eastcote, England.—1,501,332.

Tanning. Franz Hassler, Hamburg, Germany, assignor, by mesne assignments, to The Chemical Foundation, Inc.—1,501,336.

Method of Treating Molten-Metal Coating Baths and Bath Produced Thereby. Edwin R. Millring, Belleville, N. J., assignor to American Machine & Foundry Company.—1,501,356.

Apparatus for Cracking and Refining Oil. Eugene A. Reilly and Robert M. McLain, Fort Worth, Tex.—1,501,371.

Motor Fuel. Daly O. White, Portland, Me.—1,501,383.

Process for Producing Molybdates. Alan Kissock, Los Angeles, Cal.—1,501,414.

Apparatus for Separation of Air Into Its Constituents. James G. Lafferty, Coraopolis, Pa.—1,501,415.

Process of Producing Boron Carbide. Emil Podszus, Friedrichshagen, near Berlin, Germany.—1,501,419.

Electrode for High-Tension Arc Furnaces. Werner Siebert, Laufenburg, Aargau, Switzerland, assignor to Nitrum Aktiengesellschaft, Zurich, Switzerland.—1,501,420.

Process of Coloring Iron and Steel Black. Wilhelm Utendorfer, Cologne, Germany.—1,501,425.

Composition for the Destruction of Insects, Fungi, and the Like and Method of Applying the Same. Samuel Wilson, Brooklyn, N. Y.—1,501,427.

Synthesis of Ammonia. Georges Claude, Paris, France, assignor to Société l'Air Liquide (Société Anonyme pour l'Eude et l'Exploitation des Procedes Georges Claude), Paris, France.—1,501,436.

Metal-Disintegrating Apparatus. Everett J. Hall, Passaic, N. J., assignor to Metals Disintegrating Company, Inc., New York, N. Y.—1,501,449.

Process of Producing Paramidophenol and Its Compounds. Charles J. Thatcher, New York, N. Y.—1,501,472.

Method and Apparatus for Making Brick. Roy P. M. Davis, Mount Union, Pa.—1,501,479.

Process of Impregnating Paper. Leonard C. Koplin, Akron, Ohio, assignor to The Thomas Phillips Company, Akron, Ohio.—1,501,493.

Method of Manufacturing Acetaldehyde from Acetylene. Erik Gustaf Thorin, Mansbo, Avesta, Sweden, assignor to Stockholms Superfosfat Fabriks Aktiebolag, Stockholm, Sweden.—1,501,502.

Drying Process and Apparatus Therefor. Teofron Boberg, Clapham Park, London, England, assignor to Techno-Chemical Laboratories, Ltd., London, England.—1,501,513.

Drying Process and Apparatus. Teofron Boberg, Clapham Park, London, England.—1,501,515.

Process of Making Bread. William A. Darrah, Chicago, Ill.—1,501,527.

Gas and Air Reversing Valve. William G. Bergman, Point Place, Ohio.—1,501,552.

Process of Preparing Raw Linen for Bleaching Operations. Carl Bochter, Gunsburg, Germany.—1,501,553.

Lining for Cement Drying Kilns. John L. Lundberg, Alpena, Mich., assignor to Huron Industries, Inc., Alpena, Mich.—1,501,566.

Titanic Oxide Concentrate and Method of Producing the Same. Charles A. Doremus, New York, N. Y., assignor to Titanium Pigment Company, Inc., New York, N. Y.—1,501,587.

Leer Feeder. Minot K. Holmes, Muncie, Ind., assignor to Hemingray Glass Company, Muncie, Ind.—1,501,602.

Method of Making Novocaine. William A. Van Winkle, Midland, Mich., assignor to The Dow Chemical Company, Midland, Mich.—1,501,635.

Fertilizer and Process for the Manufacture of Same. Joseph Breslauer and Charles Goudet, Geneva, Switzerland, assignors to the firm: Societe d'Etudes Chimiques pour l'Industrie, Geneva, Switzerland.—1,501,645.

Electrolytic Process and Cell. James Cloyd Downs, Niagara Falls, N. Y., assignor to The Roessler & Hasslacher Chemical Company, New York, N. Y.—1,501,756.

Process for the Fixation of Nitrogen. Arthur McDougall Duckham, London, England.—1,501,760.

Green Dye-Stuffs Dyeing in Reducing Baths and Their Process of Manufacture. Louis Haas, Paris, France, assignor to Societe Chimique de la Grande Paroisse, Paris, France.—1,501,769.

Process for the Manufacture of High-Grade Flours From Fish and Like Materials. Stanley Hiller, San Jose, Calif., assignor to Roy L. Daily, San Francisco, Calif., R. R. Bellingall, Oakland, Calif., and Stanley Hiller, San Jose, Calif.—1,501,775.

Process for the Manufacture of Barium Cyanide. Camille Deguide, Enghien, France.—1,501,840.

Process of Increasing the Fineness of Ground Carbonate-Containing Minerals. Otto Reitmair, Lang Enzersdorf, near Vienna, Austria.—1,501,865.

Glassworking Apparatus. Jesse M. Said and David E. Gray, Corning, N. Y., assignors to Corning Glass Works, Corning, N. Y.—1,501,868.

Gas Producer. Charles A. Schranz, Philadelphia, Pa., assignor to Walter Wood, trading as R. D. Wood and Company, Philadelphia, Pa.—1,501,870.

Manufacture of Red Oxide of Iron. Daniel Tyrer, Stockton-upon-Tees, England.—1,501,873.

Device for Desiccating Liquid Substances. Ferdinand Wreesmann, Munich, Germany.—1,501,875.

Method and Device for Evaporating the Volatile Constituents of Solutions Emulsions, and Suspensions. Ferdinand Wreesmann, Munich, Germany.—1,501,876.

News of the Industry

Summary of the Week

The Royal Commission that has been investigating the Canadian pulpwood situation makes report urging that the government give heed to the necessity for conservation.

Foreign buyers both in Europe and West Indies are urged to attend the 1925 Exposition of Chemical Industries.

Prize winners and scholarships in prize essay contest are announced by American Chemical Society.

Calf leather tanners may appeal to Tariff Commission for reduction in duties on dyes.

Alcohol industry seeks ruling to place legal responsibility of licensed sellers, for acts of their customers.

Domestic producers of refined sodium nitrate ask duty on imports of this salt under paragraph 5 of the Tariff Act.

The fifth and sixth supplemental lists of standards of dye strengths have been issued by the Treasury Department.

The licensing system for imports of German dyes into Japan, which went into effect June 7, does not apply to reparation dyes.

Royal Commission Report on Pulpwood Is Tabled

The report of the Royal Commission investigating pulpwood resources in Canada, which was tabled in the House of Commons on Saturday July 19, makes many recommendations for forest conservation but leaves the determination of the question of prohibition of export for government decision. The Commission declares that Canada is dissipating her forest capital faster than any other nation in the world, and urges the federal and provincial governments to adopt a more vigorous policy for permanent forest protection. In respect to the question of export, the report says:

"Owing to the many intricacies involved in the pulpwood export question; in the complications as between forest conservation and trade relations; in view of the fact that the character and extent of the restrictions would necessarily depend upon the extent to which the government might otherwise go in conservation; finally as the facts have been very plainly and fully laid before the government, the commission takes the view that the actual determination of a policy must rest with the government."

The commission observes that if an export tax is adopted the revenue should be applied in forest protection through the federal and provincial services. As to the importance of some measure of protection being adopted, the report reads: "So far as this commission is concerned, we have clearly pointed to the fact that some steps must most assuredly be taken whereby the annual drain on the spruce and balsam supplies of Eastern Canada must be very greatly reduced. In some parts this object may possibly be attained by complete elimination of fire and insect losses; in other cases it can be attained by elimination of such losses plus the reduction of the amount of spruce and balsam used."

Reparation Dyes Not Included in Japanese Licensing System

Some of the satisfaction felt by the dye industry on being advised that Japan had put into effect a licensing system against German dyes, while those made in the United States were not subject to the restriction, was dissipated on the receipt of the text of the Japanese ordinance. The ordinance does put into effect a licensing system as of June 7. Import licenses are required on all coal-tar dyes and distillates, except medicinals, entering from those countries which do not have commercial treaties with Japan. The fly in the ointment, however, is the fact that the ordinance does not apply to reparation dyes. It is believed that the influence of the textile industry and other consumers in Japan has prevented the placing of restrictions on imports of reparation dyes.

Ithaca Meeting of A. C. S. May Attract British Visitors

The attendance at the Fall meeting of the American Chemical Society at Ithaca, of a considerable number of British scientists is assured. The British Association for the Advancement of Science meets in Toronto August 6. A considerable number of chemists and other professional men from Great Britain is assured. The Canadian program provides for a trip across Canada to Vancouver. The party, however, will return in time for those who desire to attend the meeting of the Chemical Society, which begins Sept. 8.

Tanners May Ask for Reduction in Duties on Dyes

The calf leather tanners declare that they are suffering to an unreasonable extent from foreign competition. Among other things they are protesting against the prices which they are being charged for dyes. Apparently they have in mind an appeal to the Tariff Commission for a reduction in the duties on the dyes which they use. Under a Senate resolution adopted at the close of the last Congress, the Department of Commerce is required, among other things, to ascertain the prices which the tanners are paying for their dyes and the prices which their competitors are paying in seven foreign countries. Since it was found that the tanning industry uses more than 100 different dyes, the tanners have just agreed that the investigation may be confined to the principal sixteen dyes which they use. They admit that even this is quite a problem since the prices of dyes vary so greatly because of the various concentrations used by different tanners in this country and by the tanners in other countries.

The manufacturers of dyes are at a loss to understand the insistence on this investigation and a reduction in duties. The duties mean much to the domestic dye makers but mean very little to the tanners, they point out. On the most expensive shoes, the dye cost, they state, does not exceed one-half cent per pair. Moreover there has been a steady reduction for five years in the prices of these dyes as the American industry has gained momentum. For an industry complaining itself of foreign competition to subject another American industry to all of the unstabilizing disturbance incident to flexible tariff proceedings, does not impress American dye-makers favorably.

News in Brief

New Paint Plant in Oklahoma—A new plant for the production of materials for paint manufacture is being arranged on site at Medicine Park, near Mountain View, Okla., taking the form of an experimental and demonstrating works, later to be extended. The pigments, or materials, will consist of a compounding of lead and zinc ores and oils. The new project is headed by O. J. Logan, Oklahoma City, Okla.; and C. C. Logan, Lubbock, Tex., who propose to organize a company, it is stated, at a later date.

Milling Machinery Specifications Coming—One of the projects to be undertaken at the Minneapolis Station of the Bureau of Mines during the next year is a study of the specifications for milling machinery. This work will be under the imemdiate charge of Mr. F. B. Foley, who is being transferred to Minneapolis. The work will include a study of construction specifications, requirements for the steels for this equipment and performance tests.

Manitoba To Have Pulp Plant—The Manitoba Pulp and Paper Co., will, it is understood, shortly establish its plant at St. Boniface. The company has a capital of $5,000,000, of which the cash outlay will be $3,600,000 in immediate operations. It is proposed to build a 200-ton newsprint mill, which will give employment when in operation to about 700 men.

Flint Glass Workers Demand Increase—A demand for an advance of 25 per cent in existing wage schedules has been made by operatives in the flint glass industry, through its central organifiation, the American Flint Glass Workers' Union, such to apply in all branches of the trade, affecting more than 400 plants throughout the country. The request has been entered despite the fact that workers in the chimney manufacturing branch have recently accepted a wage reduction in order that plants might be kept in operation.

Cumberland, Md., Artificial Silk Plant Nearly Completed—The American Cellulose & Chemical Co., Ltd., Amcelle, near Cumberland, Md., has work nearing completion on a number of buildings at its local plant and plans to begin the installation of equipment for the manufacture of artificial silk at an early date. The main mill consists of 9 individual units, in course of construction for a number of months past, representing an investment in excess of $1,000,000, complete. The plant is expected to give employment to about 2,000 operatives.

Silica-gel Plant Working in England—Cable advices from England to the Davison Chemical Co., state that the plant of the Medway Oil Refining Co., the first silica gel plant for oil refining to be completed in England, is in satisfactory and complete operation. Negotiations have been entered into by the Medway company for another plant of double the capacity of the original concern, it is stated.

Ship Paint to Be Made in Vancouver—A plant for the manufacture of a special brand of paint and composition for use on ships is to be established in Vancouver, according to Sir William Maxwell of London, England, who is representing a British company which supplies a large proportion of the antifouling paint used on ships all over the world. Sir William states there will be factories established in Vancouver and on the Atlantic coast.

Vegetable Oil Refinery at N. C. State—To conduct experimental work in the Engineering Experiment Station of the North Carolina State College of Agriculture and Engineering, to give practical instruction in chemical engineering and for special instruction for cotton oil mill managers and superintendents, a complete refining and hydrogenating plant has been installed at the college. It is planned to also install a complete crushing plant equipment.

Glue Exhibit Held in London—There is being held by The British Glues and Chemicals, Ltd., at the Laboratory, 19, Bedford Square, London, W. C. 1, an exhibition of glues, gelatines, greases, bone fertilizers and other products. The services of chemists are available for the elucidation of any problems concerning glues.

Rare Metals Production In Canada—A report issued by the Dominion Bureau of Statistics gives the production of metals of the platinum group in Canada during 1923, as follows: platinum, 1,217 ounces, valued at $141,826; palladium, 1,732 ounces, valued at $138,560; rhodium, iridium, 304 ounces, valued at $45,000. The production of the metals of the platinum group was derived almost entirely from the nickel copper ores of the Sudbury district.

Whalen Pulp Mill Re-opened

G. F. Gyles, deputy receiver for the Whalen Pulp & Paper Co., has restarted the mill at Port Alice, Vancouver Island, and is turning out 80 tons of pulp per day. Orders now on the books from the United States, Japan, and Australia will maintain the mill at this rate of capacity until the end of this year.

Negotiations now are under way with a view to reconstructing the Whalen company and introducing a large amount of United States capital into the concern. If these plans mature, the development of a large hydro-electric plant at Quatsino Sound, to provide power for the Port Alice plant, is included in the scheme. The power plant alone will cost one and a half million. The Whalen company owns three pulp mills, several saw mills, and large timber limits on Vancouver Island and also in the vicinity of Prince Rupert.

International Union May Meet With A. C. S. in 1926

An effort is being made to induce the International Union of Pure and Applied Chemistry to hold its 1926 meeting in the United States in conjunction with the fiftieth anniversary meeting of the American Chemical Society. Those of the members of the International Union, who have been consulted in connection with the proposal, say the only objection is the expense, although it is admitted that many members of that organization would be willing to expend a reasonable amount for the education and experience which would result from it. Officials of the American Chemical Society now are conferring with the railroads to see what special rates may be obtainable for a special train which would convey the visitors, during their stay, to the principal centers of the chemical industry. It is believed such a plan, which would permit of their living on the train, would reduce the expense materially.

Foreign Buyers Urged to Attend Chemical Exposition Next Year

After a two month's trip through Europe in behalf of the Tenth Exposition of Chemical Industries, which will be held during the week of Sept. 28 to Oct. 3, 1925, at the Grand Central Palace, New York, Fred W. Payne, co-manager, returned Aug. 1 to the United States. Mr. Payne, who visited most of the countries in Europe in the interest of the International Exposition Co., has been studying conditions abroad and, at the same time, stimulating interest in the Chemical Exposition to be held next year in New York, among chemical and chemical consuming interests of Europe. He spent about ten days attending the British Empire Exposition at Wembley, and visiting chemical people in England. He reports keen interest in the next American Chemical Exposition to be held a year from this coming Fall.

Following a month traveling throughout New England and Atlantic States, Charles F. Roth, co-manager with Mr. Payne of the Tenth Exposition of Chemical Industries, spent another month in the West Indies investigating the possibilities of broader use of American chemicals and equipment, and personally extending an invitation to big potential consumers of American products to attend the Chemical Exposition in New York next year. Mr. Roth spent some time among the sugar producers, and on his return recently reported that although they used chiefly British equipment at present, were much interested in new ideas in American machinery which will be displayed at the next Chemical Exposition.

Both men reported on their return, the wide interest in American products in foreign markets. Their chief efforts have been to arouse this interest to the point of bringing the big foreign buyers of equipment, and finished chemical products as well, to the Exposition in the United States in 1925, and to come with the idea of replenishing their obsolete machinery with later types which will be on exhibition.

Washington News

Producers Ask Duty on Imports of Refined Sodium Nitrate

Domestic producers of refined sodium nitrate, used extensively as a preservative of meats, have appealed to the Treasury Department to impose a duty upon importations. While classification experts of the customs division have not completed their work in this case, the indications are that refined nitrate will be declared dutiable at 25 per cent ad valorem as a chemical salt under paragraph 5 of the Tariff Act. Heretofore it has been entered free of duty.

It is contended by the domestic refiners that the phraseology of paragraph 1667 is such as to clearly preclude all save crude sodium nitrate from being admitted under this section of the free list. The paragraph reads "Sodium: Nitrate, sulphate, crude, or salt cake, and niter cake." The word "crude" evidently was intended to apply to sulphate, as this form clearly was used in previous tariff acts. However, the record shows that the Tariff Commission suggested a clarifying change in this paragraph of the bill when it was under consideration and as Congress did not make the change it is believed that the Treasury will hold that "crude" also applies to "nitrate" and hence that refined sodium nitrate should be dutiable.

Ink and Paper Specifications Adopted by Federal Board

The Federal Specifications Board has issued a new group of specifications which become mandatory for Government purchases on September 30, 1924 for various classes of ink, typewriter ribbon, paper, etc. Among these specifications are the following: no. 163—Record and copying ink, no. 164—Writing ink, no. 165—Red ink, no. 166—Stamp pad ink, no. 167—Typewriter ribbon, no. 168—Hectograph ribbon, no 169—Computing and reporting machiner ribbon, no. 177—Kraft wrapping paper, no. 178—Sulphite manilla wrapping paper, no. 179—no. 1 grade blue-print paper (sensitized and unsensitized), no. 180—No. 2 grade blue-print paper (sensitized and unsensitized), no. 181—No. 3 grade blue-print paper (sensitized and unsensitized), no. 182—Brown process paper (sensitized and unsensitized), no. 183—Upholstery leather and no. 184—Lace leather.

Vegetable Oil Investigation to Begin August 1

Four crews of investigators will be sent into the domestic field by the Tariff Commission about August 1 in connection with its inquiry into vegetable oils. Agents of the commission already are at work in the Far East and in Europe. The major investigation in the domestic field concerns costs of producing cottonseed oil, which is included in the investigation with peanut oil, soya bean oil and coconut oil.

Three crews will be sent into the South, consisting of four men each, two chemists and two accountants. One party will cover Texas and Oklahoma, another will cover plants in Louisiana, Arkansas, Alabama, Mississippi and Tennessee, and the third will cover Georgia, North and South Carolina and Virginia. The same crews will check the figures on peanut oil wherever this is produced, but most of this work will be found in Virginia. It is planned later to send two members of the Texas-Oklahoma crew to the Pacific coast to check refiners of coconut oil there.

A chemist and accountant will constitute a fourth party which will be sent through the East and North to check refiners of coconut oil in that section and to visit hardquarters of producers of other oils located in that territory.

Spontaneous Combustion Study Planned by Bureau of Chemistry

An investigation of the fundamental causes of spontaneous combustion, particularly in agricultural products, has been undertaken by the Bureau of Chemistry of the U. S. Department of Agriculture. Bacterial phenomena involved will be studied by Dr. Thom; the properties of feeds, foods and other materials subject to spontaneous combustion when heated under carefully controlled conditions will be investigated by Dr. James; and the industrial and engineering aspects of the problem will be taken up by the development division under Mr. D. J. Price.

The Bureau is anxious to learn of all cases where spontaneous combustion is apparently the cause of ignition of agricultural or industrial materials. It is hoped by field studies and a careful investigation of all fires apparently so caused to develop practical operating rules for prevention of this sort of accident.

Supplemental List of Standards of Dye Strengths

The fifth supplemental list of standards of dye strengths has been issued by the Treasury Department to be used in connection with the revised list which was promulgated early in June. The fifth supplemental list contains the names of eight standards and also lists 11 additional names of dyes corresponding to dyes already adopted as standards. The sixth supplemental list also has been issued and contains the names of 15 dyes as standards, names three for similitude and announces two corrections in the revised list made public in June.

It is apparent from the speed with which the Department is now issuing supplemental lists that the importing interests which had complained that the original list announced a year ago was insufficient to cover the subject are to have the cause of this complaint removed. The revised list issued in June contained more than twice as many dyes as the original list and supplements are being issued as rapidly as technical questions involved in classifying the dyes can be cleared away.

The dye standards are used in assessing the specific duty of 7c. per pound on coal tar colors under paragraph 28 of the 1922 tariff act, which provides that duty shall be assessed in proportion to the strength of the importation as compared to the strength of similar commercial imports prior to July 1, 1914, when most dyes were imported in lower concentrations than is the present practice.

Delay in Pronouncement on Trade Association Activities

The difficulty of explaining a policy on a controverted question may preclude the Department of Justice from making any announcement before the coming election, on trade association activities. There is reason to believe that the new Attorney General is in thorough sympathy with removing any uncertainty that may surround trade association activities. He is thought to realize, however, that it is difficult to know just how a line can be drawn which would clarify the matter. It is certain that there is no disposition to allow the study now being made of the general subject to interfere in any way with the prosecution of those who are using the trade association as a cloak to defeat the purpose of the anti-trust statutes. On the other hand, there is reason to believe that trade associations which are engaged in activities which are generally recognized as being legitimate, are in no danger of government interference.

Survey Work on Arsenic, Potash and Phosphate

With the appropriations for the new fiscal year now available, the mineral resources division of the Geological Survey is planning to give particular attention to work on potash and phosphate. The discovery of potash in various oil wells in western Texas is regarded as ample justification for increased work on that mineral. The increased attention is also justified by the fact that the Senate has passed the Shepherd bill which authorizes an appropriation of $500,000 which will make it possible to prospect with core drills and to undertake a systematic and intensive effort to learn more concerning our potash resources.

The direction of the Division of Mineral Resources recently has been placed in the hands of F. J. Katz, who succeeds G. F. Loughlin, as the chief of that Division. Mr. Katz also has in mind close attention to arsenic. While the shortage of white arsenic seems to have been relieved to some extent, Mr. Katz points out that the demand is likely to reach much higher levels in view of the fact that only a small percentage of the cotton acreage is now being treated with calcium arsenate as an agent for controlling the boll weevil. The results which have followed its use, in the opinion of specialists at the Department of Agriculture, insures its ultimate adoption on the part of cotton growers.

Alcohol Industry Seeks Ruling on Legal Points

Questions Involve Responsibility of Licensed Sellers and Payment of Taxes on Stolen or Destroyed Goods

An effort is being made to induce the Secretary of the Treasury to ask the Attorney General for an opinion on two legal points in connection with the prohibition regulations which are of great moment to the producers and consumers of industrial alcohol. The industry contends that the Prohibition Commissioner may not legally require a licensed vendor of denatured alcohol to become responsible for the acts of his customers. The other point involves the payment of taxes on alcohol which has been stolen or accidentally destroyed.

The Prohibition Unit is constantly faced by this situation: A has a permit. He sells to B. Since B has bought denatured alcohol, he is not required by the law to explain how he disposes of it. Recent action by the Unit attempts to make a part of the contract with A the requirement that his books are to be open for inspection. Thus an effort is being made to require permittees to do by indirection what prohibition agents may not do legally. Any attempt to make A responsible for what B does, it is contended, places an unwarranted responsibility on A. The Prohibition Commissioner is showing a disposition to revoke the permits of those represented by A who will not co-operate in this effort to coerce those represented by B.

There seems to be no objection on the part of the industry to the elimination of certain of the denaturing formulas which lend themselves to redistillation. The great need of the situation, however, it is pointed out, is greater care on the part of the Prohibition Bureau in the permits which it grants. Were it more circumspect, it would be entirely possible, it is declared, to keep permits in the hands of concerns who could be relied upon to deal only with customers who are above diverting alcohol to illegal purposes. The recent ruling in regard to losses of distilled spirits, which has aroused such protest from the industry, follows:

The following rules are held to apply to claims filed under Section 14, Title III of the National Prohibition Act, and Section 5 of the Act of November 23, 1921:

1. Section 14, Title III of the National Prohibition Act includes losses by theft if it is made clearly and convincingly to appear that the theft did not result from the negligence of the claimant, and was committed without his knowledge, acquiescence or collusion.

2. The words "such loss" occurring in both of the above mentioned sections of law, relate to and mean the loss of the spirits and not the loss of tax.

3. Claims filed under either of the above mentioned sections of law must set out, or must be accompanied by affidavits setting out, the following information: (a) whether the spirits involved had been sold by the claimant, and if so, what amount was received as a sale price or which may be so received; (b) whether the claimant has been reimbursed for the loss of the spirits from any source, and if so, to what extent; (c) whether the claimant is protected from the loss of the spirits by a bond, policy of insurance, liability of carrier, or other legal remedy under which the value of the spirits lost, or any part thereof, may be recovered.

4. Allowance may be made for losses of distilled spirits under Section 5 of the Act of November 23, 1921, and alcohol under Section 14, Title III of the Act of October 28, 1919, only when such losses were sustained subsequent to October 28, 1919. Claims for allowance on account of losses on or before that date must be made under statutes in force at the time the losses occurred.

5. Claims heretofore allowed under Section 5 of the Act of November 23, 1921, and Section 14, Title III of the National Prohibition Act, in accordance with rulings not consistent with those stated herein will be reopened and reconsidered and assessments made accordingly, provided the assessment is not barred by statute, in which event recovery of the taxes must be by suit.

San Antonio Cement Co. Wins Prize for Safety

Having lost less time from accidents than any other portland cement plant in the country, the San Antonio Portland Cement Co. has been awarded the Portland Cement Association's safety contest trophy. Ninety-nine cement plants participated in the safety contest which determined the winner. The Association will make this contest an annual event, carrying out its policy of co-operating with cement mills to reduce accidents.

The contest itself has been an important contributory factor in reducing the number of accidents in cement plants, according to H. G. Jacobsen, director of the accident prevention bureau of the Portland Cement Association. The cement industry's severity rate in 1923 was 5.411 days lost per 100,000 hours worked, compared with a rate of 6.504 for 1922. This is a marked reduction, whereas other basic industries showed an increase in the severity rate for this period. Fatal accidents were decreased by 30 per cent.

Permission to Make Carbon Black From Natural Gas Assured

Assurance that they will be given a permit to manufacture carbon black just as soon as they have complied with the regulations surrounding the issue of permits, has been received by officials of the Prairie Natural Gas Co., Craigmyle, Alberta, in a letter from Hon. Charles Stewart, minister of the interior. One of the stipulations is that the wells owned by the company must be capable of producing a certain amount of gas within a certain period. The company announces that three wells have been drilled and another two are expected to be started almost at once. The company believe that they will be able to produce 90 tons of carbon black a year.

Du Pont's Report Expansion in Artificial Silk Industry

In a letter to stockholders, Irénée du Pont, president of the E. I. du Pont de Nemours & Co., gives an interesting account of the development of Fibersilk in this country and incidentally touches on the growth of the artificial silk industry in general. Mr. du Pont stated that the artificial silk industry as developed during the past twenty years is an outstanding example among modern successful industrial activities. The four principal kinds of artificial silk developed to date are all produced from cellulose in the form of vegetable fiber, but the processes and products differ materially. They are nitro cellulose, cupra ammonium, cellulose acetate and viscose. The world's production of artificial silk has increased rapidly during the last two decades. the total production in the year 1923 being estimated at 90,000,000 lb., which is approximately 50 per cent more than the world's production of natural silk in the same year. In this country alone, the production of artificial silk last year amounted to approximately 35,500,000 lb.

The letter also touched upon the growth of the Du Pont Cellophane Co., which was formed in June, 1923, and which began to produce cellophane in April of this year.

Trade Notes

J. S. Cosden resigned last week, as president of Cosden & Co. and will become manager of the Lago Petroleum Co., in the United States. The Lago Petroleum Co. is controlled by the British-Mexican Petroleum Co., Ltd.

F. W. Pickard, vice-president of E. I. du Pont de Nemours & Co., has been re-elected a member of the executive committee, a position he had before being relievd some time ago to become general manager of the dyestuffs department. He will have general supervision of the company's sales department.

H. S. Mulliken is preparing a monograph on arsenic for the Bureau of Mines. The work will cover the production, consumption and methods of preparation. Mr. Mulliken was manager of the American Metals Co.'s smelters in Mexico during the war.

The Agricultural Insecticides and Fungicides Manufacturers Association has been formed by producers of those products. Officers are E. T. Trigg, president; T. S. Grasselli, vice-president; H. J. Schnell, treasurer.

Charles G. Wilson and Arthur T. Vanderbilt, ancillary receivers of the Virginia-Carolina Chemical Co., have filed a second report showing a statement of assets and liabilities of the company prepared by auditors as of March 1, 1924. The report showed that total liabilities of the company were $89,492,015 and assets $86,276,071.

Trade Commissioner Frank E. Coombs has forwarded a report from Havana, in which it is stated that there is a shortage of chlorine there, for water purification.

American Chemical Society's Prize Contest Ends

Secretary of Commerce, Herbert Hoover, chairman of the National Awards Committee of the American Chemical Society, has announced that six four-year scholarships to Yale University, consisting of tuition fees and $500 a year in cash, have been awarded to Donald L. Vivian, Phoenix, Ariz., James C. Reid, Dallas, Tex., Chandler Pittman, Commerce, Ga., Elton R. Allison, Centralia, Wash., B. Nassau, Hartford, Conn., and E. R. Brownscombe, Santa Rosa, Cal.

These awards made from the funds donated by Mr. and Mrs. Francis P. Garvan to the American Chemical Society in memory of their daughter, Patricia, are the culmination of the contest which has been conducted in the high schools and secondary schools of the United States by the Society in accordance with the wishes of Mr. and Mrs. Garvan. The primary object of the contest is to stimulate an interest in the development of chemistry in the United States and educators, as well as those members of the American Chemical Society who have been identified with it, have expressed themselves as being well pleased with the results. Over 500,000 students all over the United States competed, and six prizes of $20 in gold and certificates of honorable mention have been awarded in each of the forty-eight states and the District of Columbia. It is these state winners who were entered in the national contest, and it is from their essays that Mr. Hoover's committee has selected the six winners.

Universities granting scholarships in addition to those provided by Mr. and Mrs. Garvan are the University of Arizona, which gives two scholarships, remitting all fees; the University of Iowa, one scholarship; the University of Kentucky and the University of Mississippi, each one. In Texas the Baylor College for Women offers a scholarship worth $120, and the University of Texas offers a tuition scholarship worth $120. The University of Utah has contributed a tuition scholarship and Washington and Lee University in the State of Virginia is offering a tuition scholarship worth $80.

Both the Catholic University of America and Georgetown University have announced that they will grant four-year tuition scholarships, while the University of Virginia offers a four-year scholarship to the author of the best essay submitted in that State. The University of Florida will award two one-year scholarships, remitting registration and laboratory fees; Northwestern University offers one scholarship; the University of Maryland offers a tuition scholarship; St. Louis University a four-year scholarship, including matriculation fee, and the University of Missouri has established six fellowships for the six prize-winning essays in Missouri.

Larger Use of Fertilizers

Use of fertilizer in the cotton belt this season will aggregate about 2,090,000 tons, according to estimates of the United States Department of Agriculture. Consumption last year totaled 1,343,000 tons.

Every State reports increased use, with Georgia leading the list through the application of fertilizer to the extent of 483,000 tons. North Carolina used 406,000 tons, South Carolina 358,000 tons, Alabama 334,000 tons, Mississippi 150,000 tons and Texas 109,000 tons.

United States Gypsum Co. Builds Texas Plant

The United States Gypsum Co., Chicago, Ill., has operations under way at its new mill at Sweetwater, Tex., designed for the manufacture of wallboard and other gypsum products, and the first such mill of this character in this section. It is expected to develop maximum output at the new mill at an early date. It has a rated capacity of about 150,000 sq. ft. of wallboard and sheathing per day, while the plaster mill has an output of 400 tons daily, about one-fourth of which will be used for wallboard production. A number of different kinds of plaster will be produced, including white, or rock plaster; cement plaster and wood fibre plaster. A large tract of raw material property will be developed and used in connection with the new mill. The entire project is said to represent an investment of about $1,000,000. H. D. Humphreys is works manager at the plant, while A. M. Turner, recently of the Colorado School of Mines, has been appointed chemist in charge of quality. F. J. Gaugh will be superintendent at the wallboard mill division.

U. S. Naval Stores Representatives in France

Advices were received from France during the past week, announcing the arrival at Bordeaux of the delegation of American naval stores men who will make a study of the industry in France. President Maydieu of the Bordeaux Chamber of Commerce has arranged for the Americans to have the fullest opportunities to study the systems of production and treatment. They will drive through the pine forests to Arcachon and thence to Dax and take part in a meeting of the Naval Stores Bourse there, studying particularly the processes of distillation of turpentine by the steam bleaching of rosin, said not to be practiced in the United States.

Breithut Holds Conferences

Dr. F. E. Breithut, who recently returned from an extended investigation of chemical industries in European countries, accompanied by C. C. Concannon, the chief of the Chemical Division of the Department of Commerce, began a series of conferences with the dye and chemical interests on July 21. Two days were spent in Boston and the remainder of the week in New York. In addition to the conferences with those who could be assembled in the District office of the Department of Commerce at these points, calls were made at the offices of many concerns. This week will be spent at Wilmington, Del. and Boundbrook, N. J.

Financial

The Sherwin-Williams Co. has declared an extra dividend of 12½c. and regular quarterly dividend of 50c. on common stock, also regular quarterly 1¾ per cent on preferred.

The Texas Gulf Sulphur Co. reports for the quarter ended June 30, net earnings of $1,181,773 after federal taxes and depreciation equal to $1.86 a share on its $6,500,000 capital stock of $10 par value. The net earnings for the preceding quarter were $1,155,869, or $1.82 a share, and for the quarter ended June 30, 1923, were $1,190,190, or $1.87 a share.

For the 6 months ended July 30 the Pacific Mills' financial statement shows a net loss of $1,368,930 after reserves, compared with a profit in the corresponding period of 1923 amounting to $2,759,485, and profits of $27,383 and $1,881,902 in the corresponding periods of 1922 and 1921, respectively.

The B. F. Goodrich Co. reports for the six months ended June 30 a net profit of $2,755,017, after depreciation, interest, etc. This is equivalent, after the preferred dividends, to $2.51 a share earned on the 601,400 shares of no par value common, and compares with a net profit of $3,006,384, or $2.86 a share in the first half of 1923.

Latest Quotations on Industrial Stocks

	Month Ago	This Week
Air Reduction	79	80¾
Allied Chem. & Dye	72½	76⅞
Allied Chem. & Dye pfd	115	117⅞
Am. Ag. Chem.	7⅞	11½
Am. Ag. Chem. pfd	24	33⅜
American Cyanamid	*101	*103
Am. Drug Synd	4¼	5
Am. Linseed Co	16	21
Am. Linseed pfd	*34	41⅝
Am. Smelting & Refining Co.	64	69½
Am. Smelting & Refining pfd	100½	102½
Archer-Daniels Mid. Co. w.i.	21	21
Archer-Daniels Mid. Co. pfd	84½	84
Atlas Powder	*49	49⅞
Casein Co. of Am.	*66½	66½
Certain-Teed Products	26	25
Commercial Solvents "A"	54¼	62⅞
Corn Products (new)	34½	35¼
Corn Products pfd	121	*121
Davison Chem.	48	57½
Dow Chem. Co	*50	*50
Du Pont de Nemours	119¼	127½
Du Pont de Nemours db	88½	*88¾
Freeport-Texas Sulphur	8⅞	10
Gold Dust	35⅞	40
Grasselli Chem.	*125	*125
Grasselli Chem. pfd	*102	*102
Hercules Powder	*90	*95
Hercules Powder pfd	*103	*103½
Heyden Chem.	*1	1
Int'l Ag. Chem. Co. (new)	*4¼	6½
Int'l Ag. Chem. pfd. (ctfs.)	36	38
Int'l Nickel	14⅞	18
Int'l Nickel pfd	83	85½
Int'l Salt	*75	75½
Mathieson Alkali	43¼	41½
Merck & Co.	64	65
National Lead	143½	146½
National Lead pfd	113¾	114
New Jersey Zinc	*142	*143
Parke, Davis & Co	*80	*80
Pennsylvania Salt	82	83
Procter & Gamble	*129	*130
Sherwin-Williams	30½	28⅞
Sherwin-Williams pfd.	*101½	*101
Tenn. Copper & Chem.	6⅞	7⅞
Texas Gulf Sulphur	64½	70⅞
Union Carbide	57⅞	59⅞
United Drug	77	81⅞
United Dyewood	39½	39⅝
U. S. Industrial Alcohol	70	71⅝
U. S. Industrial Alcohol pfd	*103	103
Va.-Car. Chem. Co.	1½	1⅞
Va.-Car. Chem. pfd	3½	5⅞

*Nominal. Other quotations based on last sale.

Men You Should Know About

EDGAR C. BAIN, metallurgist and physicist recently with the Atlas Steel Corporation has joined the research staff of the Union Carbide and Carbon Research Laboratories, Long Island City, N. Y.

FREDERICK M. BECKET of the Union Carbide and Carbon Co., 1923 Perkin Medalist, who has been seriously ill for the past two weeks is greatly improved and has returned to his home from the hospital.

J. HOWARD BOWEN, chemist, of Rochester, N. Y., sailed from Vancouver, B. C., July 17, for Shanghai, China, where he will join the lithographic staff of the British-American Tobacco Co. in that country.

JACOB FRANCE, vice-president of Cosden & Co., has been elected president of the company to succeed Joshua S. Cosden, resigned. Headquarters in the future will be maintained at Tulsa, Okla.

E. G. GRACE, president of the Bethlehem Steel Corporation, Bethlehem, Pa., has sailed for England for a vacation trip.

W. S. GREENAWALT, formerly superintendent and metallurgist with the Pittsburgh Steel Co. and the Cromwell Steel Co., has been appointed openhearth superintendent at the Otis Steel Co., Cleveland, Ohio.

JOH. HÄRDEN of Stockholm, who has been in this country since the middle of June, sailed for his home July 19.

ELLERY H. HARVEY, chief chemist for the Perkins Glue Co. during the past 5 years, has entered the Graduate School of the University of Wisconsin, to pursue advanced chemical research.

HERBERT J. HOLLAND, assistant chemist of the San Francisco laboratory of the Bureau of Chemistry, has been appointed chemist in charge of the Denver station to fill the vacancy caused by the appointment of Wendell Vincent as chief of the Western district.

GORDON I. HOOVER, connected with the department of chemistry, University of Toronto, has received the exhibition scholarship of the Institution for Scientific Research. It entitles the recipient to carry on research work in universities abroad.

H. G. JAMES, formerly secretary of the Western Petroleum Refiners Association, has resigned his connection with the Derby Oil Co., Wichita, Kan., and is now making a tour of the Pacific oilfields.

E. A. MCDONALD, of the Seattle Station retired on his seventieth birthday, July 19, at his own request, from the service of the Department of Agriculture, where he has been employed for 22 years. Mr. McDonald entered the department in 1902 as a dairy inspector in the Bureau of Animal Industry. In 1907 he was transferred to the Bureau of Chemistry, receiving an appointment as food and drug inspector with station at the Seattle laboratory. Mr. McDonald was graduated from the University of Toronto with a degree of B.A. Later, as Food Commissioner of the State of Washington, he gained a special knowledge of the dairy and fish-canning industries of the Northwest that has been of great use to him.

JOSEPH MAUDRU, assistant to the general superintendent of the Great Western Sugar Co., is sailing for Europe, Aug. 2, on company business.

Dr. GEORGE F. REDDISH, of Kentucky, who has served for a number of temporary periods in the Microbiological Laboratory of the Bureau of Chemistry, was appointed an associate bacteriologist to work on the bacteriological problems of the Insecticide and Fungicide Board.

Sir ERNEST RUTHERFORD, Cavendish professor of physics in Cambridge University, is this year's recipient of the Franklin medal and certificate of honorary membership in the Franklin Institute, Philadelphia, Pa. The award was formally made on July 14 in London by Charles Trevelyan, president of the Board of Education, in the presence of a number of distinguished persons in recognition of the English scientist's achievements in physics.

ACHESON SMITH, vice-president and general manager of the Acheson Graphite Co., Niagara Falls, N. Y., has been elected a director of the American Management Association, New York.

A. M. TAYLOR was honored with a degree of Doctor of Science by Vermont University at its last commencement.

MARTIN TOSTERUD, who received his Ph.D. in physical chemistry at the University of Wisconsin for work on certain aluminum fluorides this spring, has accepted a position in the research laboratories of the Aluminum Co. of America at New Kensington, Pa.

WALTER I. WILLIS has been elected vice-president of the Three-In-One Oil Co., New York, manufacturer of lubricating oils.

C. HAROLD WILLS, metallurgist, president and general manager of the Wills-Sainte Claire Co., Marysville, Mich., has returned to the United States from a 5 weeks trip abroad.

H. E. ZITKOWSKI, general chemist of the American Beet Sugar Co., has been transferred from the Oxnard plant and now makes his headquarters in the Denver office.

Calendar

AMERICAN CERAMIC SOCIETY, summer meeting and tour, July 21 to Aug. 13.

AMERICAN CHEMICAL SOCIETY, sixty-eighth meeting, Cornell University, Ithaca, N. Y., Sept. 8 to 13.

AMERICAN ELECTROCHEMICAL SOCIETY, Detroit, Oct. 2 to 4.

AMERICAN FOUNDRYMEN'S ASSOCIATION, Milwaukee, Wis., Oct. 11 to 16, 1924.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, Birmingham, Ala., Oct. 13 to 15.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York, Dec. 1 to 4.

AMERICAN SOCIETY FOR STEEL TREATING, Boston, Sept. 22 to 26.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, Toronto, Aug. 6 to 13.

FRANKLIN INSTITUTE CENTENNIAL, Philadelphia, Sept. 17 to 19.

INTERNATIONAL MATHEMATICAL CONGRESS, Toronto, Aug. 11 to 16.

MANAGEMENT WEEK. Auspices of American Society of Mechanical Engineers, New York City, Oct. 20 to 25.

NATIONAL SAFETY COUNCIL, thirteenth annual congress, Louisville, Ky., Sept. 29 to Oct. 3.

PACIFIC COAST GAS ASSOCIATION, Santa Barbara, Calif., Sept. 15 to 19.

Obituary

W. H. ADAMS, supervisor of foods, feeds and drugs, Washington State Department of Agriculture, died in Seattle, on June 7, according to a report from W. S. Frisbie, Office of Cooperation.

HOWARD F. CHAPPEL, retired chemist and metallurgist, as well as banker, died at his residence, Hotel Lorraine, New York, July 17, aged 62 years. He was graduated from the Sheffield Scientific School, Yale University, in 1881, and took post-graduate scientific studies in Germany. Following, with his father, William Henry Chappell, he founded the Chappell Chemical Co., Chicago, Ill. He is survived by his wife and one daughter.

GEORGE A. LUDINGTON, vice-president of the Fisk Rubber Co., Chicopee Falls, Mass., died at Springfield, Mass., July 18.

JOHN W. PHILLIPS, president of the Aborn Steel Co., New York, died at his home at Glen Ridge, N. J., July 6, after 6 months illness, of kidney trouble. He was known as an expert in the steel industry and followed this branch of business throughout his career. He is survived by two sons and a brother.

ROBERT C. SWEETZER, professor of chemistry, Worcester Polytechnic Institute, Worcester, Mass., died recently at his home in that city at the age of 81 years. Following his graduation from the Institute, he was made a member of the faculty in the chemistry department, and continued in this capacity for many years thereafter.

New Potash Plant Increasing Scale of Operations

The United States Industrial Chemical Co. is developing full capacity at its new plant at Baltimore, Md., recently completed at a cost of about $750,000, and purposes to add to the working force until maximum is reached. The works are given over to the production of potash, ammonium sulphate and kindred chemical products, using as raw material the refuse of the neighboring plant of the United States Industrial Alcohol Co., an affiliated organization, which manufactures industrial alcohol under a special process from molasses. The new plant is the only potash-producing works in this section and said to be the only one in existence using the source of raw material noted.

Market Conditions

Sellers Report More Optimistic Feeling in Chemical Market

Buying Orders Still Irregular But Consuming Trades Are Regarded as Working Into Better Position

IMPROVEMENT in demand for chemical products is not substantial enough to bring about any change in trading conditions. A more optimistic tone, however, prevails on the selling side of the market. Reports from the textile trade generally indicate an expansion of operations and the soap and paint industries are more encouraging. Following the shutdown of some glass factories, production of glass has gained in volume and reports from that field presage improved demand. The report states that stocks of glassware for table, home and decorative purposes are low throughout the country, and buyers are expected to place orders soon for the fall and holiday business. Demand for illuminating glassware and plate glass has shown an improvement, but building glass remains slow. Demand for flat glass has been such that prompt shipment has not been possible and orders are being filled from 4 to 10 weeks behind receipt. Glass specialties—both lighter and heavier than ordinary window glass—are moving well.

The weighted index number again moved upward, largely owing to a strong market for cottonseed oil. As far as chemicals are concerned, the week was featured by a scarcity of price changes. It is true that some chemicals are irregular in price due to selling competition but sellers generally feel that open price reductions would fail to stimulate trading.

The unsatisfactory position of the insecticide trade has brought producers into closer harmony and an association has been formed which may result in placing that business on a more stable footing. Calcium arsenate remains in a depressed state and while reports of threatened weevil damage were in circulation last week, it is doubtful if the buying movement will be increased enough to take up surplus stocks now held by manufacturers.

Interest was drawn to refined nitrate of soda by reports that domestic producers had appealed to the Tariff Commission to declare importations dutiable at a rate of 25 per cent ad valorem. At present refined nitrate is on the free list, or at least has been so considered, and the present contention that it should pay an import duty is based on the wording of the tariff act.

Acids

Conditions in the market for acids have undergone no material change during the week. With few exceptions trading is slow and while there is a better feeling among sellers regarding prospective buying, it is conceded that interest has not yet gained in any appreciable way. Good business is reported for citric acid with the domestic product coming in for most attention from buyers. In some cases importers are meeting the prices quoted by domestic producers of citric but foreign markets are reported to be above a replacement basis. Tartaric acid has sold rather freely with imported offered at 27c. per lb. and domestic generally held at 30c. per lb. Boric acid is moving in a fairly normal way but stocks in sellers hands are thought to be large. Lactic acid has been in firm hands and while some industries have failed to take their usual quotas, the total movement from producing centers has been regarded as satisfactory and the market has been free from selling pressure. Prices for the higher grades of phosphoric acid are firm but the lower grades have been freely offered with not much buying interest. Of the mineral acid group nitric appears to be in the firmest position. Production has been cut down to a point where some sellers are said to be well cleaned out and prices vary according to seller. Sulphuric acid is moving moderately but new business is light and sellers are not pushing matters.

Nitrite of Soda Firmer—Bichromate of Potash Weak—Copper Sulphate Dull and Easy—Improved Demand for Caustic Soda—Arsenic Holds Unchanged Position—Calcium Arsenate Neglected—Stocks of Nitric Acid Reduced—Yellow Prussiate of Potash Steady

Potashes

Bichromate of Potash—Offerings in some quarters have continued free and prices show very little stability. Consumers claim to have no difficulty in finding supplies at 9c. per lb. but demand, both for home and export, is light and only small lots are moving. Asking prices range from 9c. to 9¼c. per lb. according to seller.

Carbonate of Potash—The market is not under selling pressure but with actual business placed of small proportions, it has been difficult to hold values steady whenever buyers showed an inclination to take on this material. As a result the price tone is easy and hydrated 80-85 per cent has been offered at 5¾@6c. per lb., calcined 80-85 at 5½@5¾c. per lb., and 96-98 per cent at 5¾c. per lb.

Caustic Potash—Arrivals from different foreign ports were noted during the week. Quotations of 6¾c. per lb. for spot caustic are still heard but they are purely nominal as different sellers are looking for business at 6½c. per lb. and offerings at the latter figure are large enough to take care of current buying. Shipments from European points are offered at 6½c. per lb.

Prussiate of Potash—Red prussiate of potash is very quiet and prices are nominal with holders said to be receptive to bids. Yellow prussiate has maintained a firm position on spot for several weeks and the open quotation still gives 18½c. per lb. as the lowest price at which sellers will accept business. Futures are less firmly held and it was possible to do 17½c. per lb. in the past week on forward deliveries.

Sodas

Acetate of Soda—Attempts to place the carlot quotation on a level of 5c. per lb. at works have failed to strengthen the market and 4½c. per lb. remains as an open quotation. Demand is held down to moderate amounts for prompt shipment and evidently sellers are carrying a large surplus at producing points.

Bichromate of Soda — Deliveries against contracts are said to have been in better demand but new orders are coming to hand in an irregular way and the market is described as quiet. Asking prices have held at 7⅛@7¼c. per lb. depending on seller and quantity.

Caustic Soda—Jobbing call was more consistent and considerable inquiry for export developed. In the early part of the week there were quotations for export at 2.75@2.80c. per lb. f.a.s. but later on holders of stocks were firmer in their views and 2.90c. per lb. f.a.s. was the lowest price heard. There has been no change in the position of leading producers and the contract price to domestic consumers holds at 3.10c. per lb., carlots, at works. Ground and flake caustic are offered at 3½c. per lb., carlots, at works, on contract.

Nitrate of Soda—The main feature in the market for refined nitrate of soda was found in reports from Washington to the effect that efforts were being made to have this product placed on the dutiable list. It is contended that the paragraph placing nitrate of soda on the free list stipulates crude

nitrate and that the refined according to interpretation of the existing tariff law should be dutiable at 25 per cent ad valorem. First hands continue to quote refined nitrate at 4¼c. per lb. for granulated, 5¼c. per lb. for powdered, and 5c. per lb. for crystals. Crude nitrate is quiet with very little demand and with very little spot material.

Nitrite of Soda — While there are rumors that 8½c. per lb. can still be done, the asking price has been advanced to 8¾c. per lb. for German and Norwegian is quoted at 9c. per lb. Domestic nitrite is offered at 9c. per lb. at works and the tone of the market is firm. Under these conditions it is doubtful if rumors of 8½c. per lb. material have any foundation in fact.

Prussiate of Soda—Buyers were favored by price developments as the market was said to be subject to some price shading. Holders of this material claimed that 9½c. per lb. was the lowest price obtainable and they were skeptical of sales reported under that level if such sales applied to spot goods. On shipments imported prussiate was offered at 9⅝c. per lb. with a possibility that 9½c. per lb. could be done.

Miscellaneous Chemicals

Arsenic—The movement of domestic arsenic is said to be relatively good with buyers taking on prompt and also later positions. Sales of round lots are reported to have been made at 7¾c. per lb. Imported material is not active but stocks are not being pressed for sale although one large lot was said to have been offered at 7⅝c. per lb. subject to buyer taking the entire amount. The market, however, is holding fairly steady at 7¾c. per lb. for spot Japanese and 8c. per lb. for European.

Barium Chloride — Domestic producers of barium products are well sold ahead and asking prices are above the levels held for the imported. Demand for the latter has slowed up and spot holdings of barium chloride were available last week at $78 per ton. Barium carbonate also was dull with quotations at $60@$61 per ton.

Calcium Arsenate—A survey of boll weevil conditions in Georgia has been completed by county agents, showing that the rainy, cloudy weather of July has been favorable for weevil development and the second generation threatens to be destructive where poisons have not been used. This report from the region which is the largest consumer of arsenate seems to favor a late buying movement but very little optimism is found in trade circles and the market is a dull affair. No large business is reported by Northern producers. Values are irregular with 9c. per lb. for carlots at works, as the prevailing quotation.

Copper Sulphate—Buying has slowed down materially and this has increased competition. Prices are unsettled and imported material is said to have been offered at 4c. per lb. Some sellers of domestic also have named low prices but 4.40c. per lb. is maintained in some quarters.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	**161.00**
Last week	157.82
July, 1923	171.00
July, 1922	156.00
July, 1921	148.00
July, 1920	274.00
July, 1919	231.00
July, 1918	277.00

Strength in vegetable oils and moderate gains in miscellaneous chemicals resulted in a 318 point rise in the weighted index number.

Sal Ammoniac — In spite of only moderate buying interest, the market for white imported sal ammoniac has held steady and spot goods were maintained at 6⅜@6½c. per lb. according to seller. Shipments were on the same level as a week ago with 6¼c. per lb. the general quotation.

Salt Cake—This material has been under pressure as far as nearby deliveries were concerned but most sellers are said to be reserved on contracts calling for deliveries over distant months. Prices have shown a range according to seller with the works price varying from $17 to $20 per ton.

Alcohol

While no price changes occurred in the past week there was some improvement in sentiment and the undertone was firmer in most quarters of the trade. The recent reduction in the selling schedule induced buying on a larger scale. Denatured alcohol, formula No. 1, special, was available at 43@43½c. per gal., in drums, carload lots.

First hands reported a more favorable situation in methanol, but the prices closed unchanged on the basis of 75c. per gal. for the pure, tank car shipments, f.o.b. works. The 95 per cent grade, in cooperage, was offered at 74c. per gal., carload lots.

Coal-Tar Products

Trading Restricted—Benzene Firm on Limited Holdings— Further Weakness in U.S.P. Phenol—Aniline Oil Steady

REPORTS on the condition of the steel industry were a little more encouraging and it was felt that this should soon lead to greater activity at producing centers. As matters stand the production of light oils is down to a minimum and supplies are barely sufficient to meet ordinary demands. This accounts for the comparatively steady position of the market for benzene. A feature in the trade in coal-tar products was the continued unsettlement in phenol. There were offerings through first hands at concessions, covering fairly large parcels for nearby as well as forward delivery. The market for refined naphthalene was quotably unchanged, with the undertone weak on selling pressure. Aniline oil was quiet, but moderate stocks caused prices to hold fairly steady in all quarters. Pyridine was offered a little more freely, both spot and forward delivery. Paranitraniline was neglected.

Aniline Oil and Salt—Small lot transactions were the rule. Leading makers maintained prices on the carload basis of 16c. per gal., in drums, f.o.b. works. Small lots brought as high as 17c. per lb. on spot. Aniline oil for red held nominally at 40c. per lb. The market for salt was dull and prices nominal at 22@23c. per lb. Export trade was absent in both oil and salt.

Benzene—The fact that news from the steel producing centers has improved somewhat led traders to believe that production of benzene should soon increase. Demand was fair in the past week and with stocks comparatively small a firm undertone prevailed in all directions. Producers still quote 23c. per gal. for the 90 per cent, and 25c. per gal. for the pure, tank cars, f.o.b. works.

Beta-naphthol — Demand was slow and prices barely steady, thought unchanged at 24@25c. per lb., for the technical, prompt shipment from works.

Creosote—Domestic production being sold up on contract open quotations are no available. The English market continues quiet and easy and offerings continue at 6¼@6½d. per gal., loose, f.o.b. point of shipment.

Cresylic Acid—The past week witnessed the arrival of several lots from abroad. The market appears to be well supplied and prices are unsettled. Quotations on pale 97 per cent acid ranged from 63@68c. per gal., depending upon color, seller and quantity. Manchester, England, quoted 2s.@2s. 3d. per gal. on goods suitable for shipment to America.

Naphthalene—Market on refined dull and prices easy. White flake for immediate delivery offered at 4¾@5c. per lb., while even lower prices have been named on special lots. Chipped naphthalene nominal at 4¼@4½c. per lb. English sellers quote crude of good quality at £8@£9 per ton, works.

Paranitraniline—No improvement in business, but sellers not forcing the market. Quotations repeated at 68@72c. per lb., as to seller and quantity.

Phenol — Producers offered U.S.P. phenol for nearby delivery at 24c. per lb., in large drums, a decline of 1c. for the week. Small lots sold on spot at 26c. per lb. The buying was hand-to-mouth in character and with some surplus material around the market presented an easy undertone. The situation is not likely to change until the call for phenolic resins improves.

Pyridine — Imported material was available for immediate delivery at $3.70@$3.75 per gal. Demand was quiet and prices barely steady. Foreign markets held steady, according to importers.

Solvent Naphtha—Stocks small and moderate buying was sufficient to maintain prices on the basis of 25c. per gal., for the water white, tank cars, f.o.b. works.

Vegetable Oils and Fats

Strong Market for Crude and Refined Cottonseed Oil— Nearby Linseed Firm—Coconut, Corn and Palm Oils Higher

THE trend of prices for oils and fats was upward. New highs prevailed during the week for crude and refined cottonseed oil, offerings being scanty on the bullish statistical situation, as well as continued strength in grains and provisions. Competing oils were all higher, good business taking place in sesame and corn oils. Coconut oil advanced on increased buying interest. China wood was up on small offerings. Palm oils advanced in foreign and domestic markets. Tallow sold at an advance, with the market strong even at the higher figure. Round lots of crude menhaden oil were disposed of at unchanged prices.

Cottonseed Oil—Consumption of refined cottonseed oil during the month of June amounted to 153,000 bbl., which compares with 179,000 bbl. in May and 143,000 bbl. in June a year ago. The showing was not quite up to expectations, but enough oil was shipped out to support the contention of bulls that the statistical situation at the end of the season will be even stronger than a year ago. The visible supply of oil on the last day of June was estimated at 503,000 bbl., which compares with 512,000 bbl. a year ago. The past week saw some good buying of oil by consumers and compound makers, and prices paid were the highest for the season. One round lot of bleachable oil sold at 12½c. per lb., loose, f.o.b. Chicago. Prime summer yellow on spot sold at 13c. per lb. in cooperage. Winter oil on spot sold in a fair way at 15c. per lb., in cooperage. Crude oil sold in Texas at prices ranging from 10¾@11c. per lb., tank cars, f.o.b. mills. July prime summer yellow, in the New York option market, on Thursday, closed at 12½c. bid and 13c. asked, with October at 11.68c. bid and 11.69c. asked, and January at 10.66c. bid and 10.74c. asked. In a speculative way the market was fairly active, traders following closely the movement in grains and provisions. The strength in hogs was a feature. Pure lard in Chicago was quoted nominally at 12.70c. per lb., cash. Lard compound in the New York market was raised to 14½@15c. per lb., carload lots. Developments in the cotton situation were unfavorable, the latest report by the Department of Agriculture indicating a crop of 11,934,000 bales.

Linseed Oil — The flaxseed markets were slightly lower, but crushers did not change the selling schedule for oil. The quantity of Argentine seed now afloat is small, and, with reports from the Northwest less favorable, crushers take the stand that the stocks of oil will remain light during the next two months. This accounted for the lack of selling pressure. Demand was only fair. The open quotation for August-September oil was $1 per gal., in bbl., carload lots, but on a firm bid it was possible to obtain supplies from certain sellers at 98c. per gal. October delivery closed nominally at 94@96c. per gal., with November-December at 90@92c. per gal., carload lots, cooperage included. Imported linseed oil on spot was offered at 96c. per gal., with futures available at 91c. per gal. It was reported that some oil was offered containing approximately 5 per cent of soya bean oil, this material being available at concessions. Crushers have experienced a little difficulty in landing Argenine seed at New York because of the regulations against importations of grains from countries where the hoof-and-mouth disease is prevalent. Argentine shipments of seed since the first of the year amounted to 40,994,000 bu., which compares with 36,840,000 bu. for the corresponding period a year ago. Buenos Aires quoted the September option at $1.98 per bu. At Duluth July seed closed on Thursday at $2.52½, and September at $2.37 per bu. Linseed cake for export sold at $43 per ton, f.a.s. New York, an advance of $2 per ton.

Cottonseed Statistics for 11 Months Ended June 30

Consumption of cottonseed oil in June amounted to 153,000 bbl., which compares with 179,000 bbl. in May and 143,000 bbl. in June a year ago. Cottonseed and cottonseed products statistics for the 11 months ended June 30, with a comparison, follow:

	August — June 1923-24	August — June 1922-23
Seed received, ton..	3,309,047	3,231,770
Seed crushed, ton....	3,285,102	3,226,771
Crude oil mfd., lb....	972,355,603	994,263,042
Ref'd oil mfd., lb.....	837,091,308	899,069,286
Stocks June 30:		
Seed, ton........	29,285	13,526
Crude oil, lb......	23,338,071	11,833,240
Ref'd oil, lb......	172,534,924	190,442,987
Exports, 11 months:		
Crude oil, lb......	23,406,602	25,625,475
Refined oil, lb....	14,207,753	37,041,624
Cake and meal, tons..........	119,772	221,173

China Wood Oil—Offerings have dried up, and, with the Oriental market firm, prices advanced in all directions. Spot oil in bbl. was raised to 14¾@15¼c. per lb., the top figure prevailing in most instances. On tank car shipments from the Pacific coast 13@13¼c. represented the market.

Coconut Oil—Scattered business was reported in August shipment Ceylon type oil at 8½c. per lb., tank cars, f.o.b. Pacific coast, an advance of ¼c. Spot and nearby oil in New York sold at 8¾@9c. per lb., tank cars, the top figure obtaining at the close.

Corn Oil—Crude corn oil sold at 11c. per lb., tank cars, f.o.b. Chicago, an advance of ¾c. for the week.

Palm Oils—One lot of 750 tons of September shipment Niger oil sold at 7.75c. per lb. Lagos was raised to 8½c. per lb. on spot, and 7.90c. for future shipment from Africa.

Rapeseed Oil — English refined oil afloat sold at 81c. per gal. Most traders now ask 82½c., spot and shipment.

Sesame Oil—Several round lots of refined oil were traded in for Aug.-Sept. shipment from the other side. Early in the period 11.86c. was paid, but later 12½c. represented the trading level, basis c.i.f. New York.

Soya Bean Oil — The Pacific coast market settled at 10¼@10½c. per lb., tank cars, duty paid. Trading inactive.

Fish Oils—Approximately 5,000 bbl. of Northern made crude menhaden oil sold at 37½@40c. per gal., tank cars, fish factory. Several cars sold in Baltimore at 40c. per gal., same terms. Late in the week 45c. was asked by Southern producers. Fishing in Northern waters was good, while operations in the South were spotty. Newfoundland cod oil was nominal at 58@60c. per gal.

Tallow, Etc. — Extra special tallow sold at 7⅝c., an advance of ¼c. This price was bid for additional lots, but sellers raised their views to 8c. Oleo stearine sold at 14@14¼c.

Miscellaneous Materials

Antimony — Slight improvement in demand and market advanced about ½c. per lb. China reported firm prices. Spot Chinese antimony settled at 8.35@8.50c. per lb. Cookson's "C" brand 11½@11¾c. per lb. Chinese needle, lump, nominal at 8½@9c. per lb. Antimony oxide, white, 10@10½c. per lb.

Casein—Heavy importations of Argentine casein took place within the past week. Market inactive and prices nominal at 10½@12c. per lb. on the lower grades.

Glycerine—Chemically pure was firm at 17c. per lb., in drums, immediate delivery. Dynamite nominal at 16½c. per lb., in drums, carload lots. Soap lye crude, basis 80 per cent, loose, 11c. asked, Eastern territory. Offerings moderate, both here and in the West.

Lithopone — Arrival of foreign material continues. Domestic offered at 6½c. per lb., in bags, carload lots, prompt and forward delivery. Undertone barely steady because of keen competition. Most consumers covered for remainder of year requirements.

White Lead—The fact that pig lead advanced to 7¼c. per lb., caused sentiment in the market for pigments to change for the better. All sellers were not firm in their views. Leading factors continued to quote the market on standard dry white lead (basic carbonate) at 9¾c. per lb., in casks or bbl., carload lots. Demand was quiet so far as new business was concerned.

Zinc Oxide—No further changes took place in the market for oxide. Demand was fair, with competition for business pending keen. American process, lead free, quoted at 7¾c. per lb., in bags, carload lots.

Picric Acid Used to Clear Land

More than 45,000 farmers in twenty-eight states have used picric acid to clear 250,000 acres of land and to remove stumps from about 86,000 acres, according to the American Chemical Society. Nearly 8,000,000 pounds of this surplus war explosive have been applied to agriculture by the U. S. Bureau of Roads.

Imports at the Port of New York

July 18 to July 24

ACIDS—Cresylic—4 dr., Glasgow, Order; 200 dr., Antwerp, Lunham & Moore, 12 dr., Liverpool, E. H. Watson. **Citric**—200 bbl., Genoa, L'Appula Soc. Anon. **Formic**—140 damijohns, Rotterdam, R. W. Greeff & Co. **Oxalic**—15 csk., Rotterdam, R. W. Greeff & Co. **Tartaric**—8 kegs, London, Order; 200 csk., Rotterdam, Order.

ALCOHOL—150 bbl. denatured, Arecibo, C. Esteva.

ALUMINUM HYDRATE—450 bg., Rotterdam, R. W. Greeff & Co.

AMMONIUM BICARBONATE—125 csk., Hamburg, Order.

ANTIMONY—250 bg. crude, Shanghai, Wah Chang Trading Corp.; 100 bg., Marseilles, Order.

ANTIMONY REGULUS—500 cs., Shanghai, W. Schall & Co.; 500 cs., Shanghai, W. R. Grace & Co.

ARSENIC — 15 kegs, London, L. H. Butcher & Co.

BARIUM CHLORIDE—79 csk., Bremen, C. Tennant Sons & Co.

BARYTES—250 bg., Hamburg, Cooper & Cooper; 25 csk., Hamburg, A. Hurst & Co.; 64 csk., London, Toch Bros.; 200 bg., Rotterdam, Schall Color & Chem. Co.; 500 bg., Rotterdam, E. L. Bullock & Sons.

BRONZE POWDER—12 cs., Bremen, B. F. Drakenfeld & Co.; 7 cs., Bremen, Order.

CALCIUM CITRATE—88 csk., Messina, Order.

CASEIN—1,667 bg., Buenos Aires, Order; 333 bg., St. Nazaire, Equitable Trust Co.; 825 bg., Buenos Aires, Kalbfleisch Corp.; 2,500 bg., Buenos Aires, Order; 834 bg., Buenos Aires, National City Bank; 2,501 bg., Buenos Aires, Order.

CHALK—275 bg., Bristol, H. J. Baker & Bro.; 600 bg., Antwerp, National City Bank; 445 bg., Antwerp, T. Downing & Co.; 554,000 kilos, Dunkirk, Taintor Trading Co.; 500 bg., Antwerp, L. H. Butcher & Co.; 1,000 bg., Antwerp, Reichard-Coulston, Inc.

CHEMICALS—33 csk., Bremen, Roessler & Hasslacher Chem. Co.; 6 cs., Havre, F. B. Vandegrift & Co.; 16 pkg., Hamburg, Order; 62 csk., Rotterdam, Roessler & Hasslacher Chem. Co.; 150 csk., Rotterdam, H. Hinrichs Chem. Co.; 339 pkg. Rotterdam, Order; 38 cs., Rotterdam, Dissoway Chem. Co.; 40 cs., Rotterdam, Roessler & Hasslacher Chem. Co.

CLAY—420 bg. burnt, Hull, H. A. Robinson & Co.; 334 bg. china, Bristol, C. T. Wilson & Co.; 300 tons do., Bristol, Hammill & Gillespie; 626 tons do., Bristol, Moore & Munger; 60 tons do., Bristol, Paper Makers Imp. Co.

COLORS—250 bg. blue, Hull, Recketts, Ltd.; 54 csk. blue, Hull, Van Oppen & Co.; 20 cs. dry, London, R. F. Downing & Co.; 6 csk. aniline, Hamburg, American Aniline Products, Inc.; 4 csk. do., Hamburg, Kuttroff, Pickhardt & Co.; 2 cs. aniline, Havre, Fezandie & Sperrle; 48 cs. do., Havre, Ciba Co.; 600 kegs indigo paste, Shanghai, E. I. du Pont de Nemours & Co.; 2 csk., Havre, Irving Bank-Col. Trust Co.; 5 csk. aniline, Havre, Geigy Co.; 4 dr., Antwerp, Ackerman Color Co.; 8 csk. aniline, Rotterdam, American Aniline Products, Inc.; 31 csk. do., Rotterdam, Kuttroff, Pickhardt & Co.; 4 bbl. zinc yellow, Rotterdam, Reichard-Coulston, Inc.; 200 csk., Bordeaux, Heemsoth, Basse Co.

DIVI-DIVI—533 bg., Maracaibo, Paris & Co.

FERROCOBALT — 2 cs., Liverpool, De Courcy, Browne, Inc.

FERROMANGANESE—250 cs., Havre, Order.

FUSTIC—490 tons, Kingston, Order.

GARNET ORE—6,600 bg., Almeria, Herman Besh & Co.

GALLNUTS — 100 cs., Shanghai, Lincoln Alliance Bank, Rochester.

GYCERINE — 60 dr. crude, Antwerp, Order.

GRAPHITE—600 pkg., Havre, J. Elwell & Co.

GUMS — 250 bg. arabic, Sudan, P. E. Anderson & Co.; 400 bg. do., Sudan, Order; 128 bg. copal, Singapore, Order; 270 bg. copal, Antwerp, Brown Bros. & Co.; 420 bg. copal, Antwerp, W. Schall & Co.; 216 bg. copal, Manila, Chartered Bank of India, Australia & China; 150 bg. do., Manila, Innes & Co.; 100 cs. damar, Singapore, Philadelphia National Bank; 360 bg. copal, Antwerp, Order.

IRON OXIDE—33 csk., Hull, J. Lee Smith & Co.; 320 bg., Bristol, C. Z. Collins & Co.; 100 csk., Bristol, Order; 15 csk., Antwerp, Reichard-Coulston, Inc.; 20 bbl., Malaga, A. D. Strauss & Co.; 261 bbl., Malaga, C. K. Williams & Co.; 46 bbl. Malaga, C. J. Osborn Co.; 46 bbl., Malaga, L. H. Butcher Co.; 156 bbl. Malaga, C. K. Williams & Co.; 50 bbl., Malaga, Order.

LEAD ACETATE—17 csk., Rotterdam, Jungmann & Co.

LITHOPONE—75 csk., Antwerp, E. M. & F. Waldo; 3 csk., Antwerp, Standard Textile Co.; 80 bbl., Hamburg, Order; 40 csk., and 40 bbl., Rotterdam, Reichard-Coulston, Inc.

LOGWOOD—60 tons, Kingston, Order.

MAGNESIUM—20 cs. calcined, Hull, F. Stearn & Co.; 50 cs. do., Hull, McKesson & Robbins.

> ## Opportunities in the Foreign Trade
>
> *Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.*
>
> CELLULOID in sheets. Rio de Janiero, Brazil. Purchase.—11,013.
>
> CHEMICALS. Bombay, India. Purchase and agency.—11,023.
>
> CHEMICALS, heavy. Bahia, Brazil. Agency.—11,006.
>
> CHEMICAL PRODUCTS. Santiago, Chile. Exclusive agency.—11,040.
>
> MATCHES. Bombay, India. Purchase and agency.—11,023.
>
> PAINT, black japan. Huddersfield, England. Purchase.—10,994.
>
> SODA CAUSTIC. Bahia, Brazil. Agency.—10,997.
>
> SODA, CAUSTIC. Bahia, Brazil. Agency.—11,004.
>
> SULPHUR. Vienna, Austria. Agency.—10,995.
>
> SULPHUR. Bahia, Brazil. Agency.—11,006.

MAGNESITE—621 bg., Glasgow, Order; 118 bbl. and 500 bg., Rotterdam, Speiden, Whitfield Co.; 196 pkg., Rotterdam, A. Kramer & Co.

MINERAL EARTH—110 bbl., Hamburg, Order.

MINERAL WHITE—100 bg., Hull, Whittaker, Clarke & Daniels; 100 bg., Hull, Brown Bros. & Co.

OILS—China Wood—144 csk., Shanghai, Irving Bank-Col. Trust Co.; 150 bbl., Shanghai, Viele, Blackwell & Buck. **Coconut**—872 tons (in bulk), Manila, Procter & Gamble. **Castor**—112 bbl., Hull, Brown Bros. & Co. **Cod**—100 bbl., Hull, Order; 120 csk., St. Johns, National Oil Products Co.; 120 csk., St. Johns, National Sponge & Chamois Co.; 40 csk., St. Johns, Order. **Linseed**—150 bbl. and 1 lot in bulk (quantity not specified), Hull, Order; 145 bbl., Rotterdam, Order. **Olive foots** (sulphur oil) —300 bbl, Patras, Order. **Neatsfoot**—60 tcs., Buenos Aires, Wilson & Co.; 29 csk., Montevideo, Wilson & Co. **Palm kernel**—107 bbl., Hull, Order. **Palm**—412 csk., Hamburg, African & Eastern Trading Co.; 80 csk., Rotterdam, Order. **Rapeseed**—490 bbl., Hull, J. C. Francesconi & Co.; 300 bbl., Hull, Order; 25 dr. and 50 bbl., Rotterdam, J. C. Francesconi & Co. **Sesame**—50 bbl., Antwerp, Order; 198 bbl., Rotterdam, J. H. Rayner & Co. **Sperm**—25 bbl., Glasgow, Order. **Soya Bean**—200 bbl., Rotterdam, Cook & Swan Co.; 50 bbl., Copenhagen, Order.

OIL SEEDS—Linseed—33,322 bg., Buenos Aires, Spencer Kellogg & Sons; 73,120 bg. and 4,225,256 kilos (in bulk), Buenos Aires, Order; 17,300 bg., Buenos Aires, L. Dreyfus & Co.; 34,451 bg., Buenos Aires, Order.

PITCH — 144 bbl. soft cotton, Genoa, Order.

POTASSIUM SALTS—26 csk., Bremen, P. H. Petry & Co.; 5,000 bg. muriate, Bremen, Potash Import Corp. of America; 8 csk. chlorate, Hamburg, Seaboard National Bank; 20 csk. perchlorate, Antwerp, Bernard, Judae & Co.; 30 cs. caustic, Gothenburg, Mallinckrodt Chemical Works; 932 bg. nitrate, Rotterdam, Kuttroff, Pickhardt & Co.

PYRITES—7,023 tons, Huelva, Pyrites Co.

QUEBRACHO—3,550 bg., Buenos Aires, Goldman, Sachs & Co.; 847 bg., Buenos Aires, Standard Bank of South Africa; 19,724 bg., Buenos Aires, International Products Co.

ROCHELLE SALT—99 csk., Rotterdam, Order

ROSIN—155 csk., Bordeaux, American Express Co.

SAL AMMONIAC—150 csk., Bristol, C. de P. Field & Co.; 118 csk., Rotterdam, Roessler & Hasslacher Chem. Co.

SHELLAC—24 cs., Hamburg, A. Helmrath, Inc.; 100 bg., London, Order; 50 chests, Hamburg, A. Helmrath, Inc.

SODIUM SALTS—100 dr. sulphite, Bristol, R. F. Downing & Co.; 20 cs., peroxide, Havre, C. Hardy, Inc.; 140 csk. hyposulphite, Hamburg, Order; 150 csk hyposulphite, Antwerp, East River National Bank; 99 bbl. phosphate, Antwerp, A. Klipstein & Co.; 20 cs. caustic, Gothenburg, Mallinckrodt Chemical Works; 29 cs. bromide, London, Order; 82 csk. phosphate, Copenhagen, Order; 73 csk. prussiate, Rotterdam, Meteor Products Co.; 26 csk. prussiate, Rotterdam, Order; 14 csk. prussiate, Rotterdam, Order; 2,411 bg. nitrate and 77 csk. nitrite, Skien, Order; 46 csk. prussiate, Liverpool, C Tennant Sons & Co.; 224 dr. cyanide, Liverpool, Order.

STARCH—200 bg. potato, Copenhagen, Stein, Hall & Co.; 100 bg. do., Rotterdam, National Gum & Mica Co.; 25 bbl. do., Rotterdam, Stein, Hall & Co.; 200 bg. do., Rotterdam, Spier, Simmons & Co.; 250 bg. do., Rotterdam, A. Hoffmann & Co.

TALC—300 bg., Genoa, C. Mathieu; 500 bg., Bordeaux, L. A. Salomon & Bros.; 300 bg., Bordeaux, C. B. Chrystal & Co.; 550 bg., Bordeaux, Whittaker, Clark & Daniels.

TANNING EXTRACT—40 bbl., Antwerp, Brown Bros. & Co

TARTAR—24 csk., Naples, Royal Baking Powder Co.; 112 bg., Rotterdam, C. Pfizer & Co.; 250 bg., Alicante, C. Pfizer & Co.; 194 bg., Lisbon, C. Pfizer & Co.; 121 bg., Valencia, Royal Baking Powder Co.; 134 bg., Valencia, C. Pfizer & Co.; 200 bg., Bordeaux, Order.

UMBER—200 bg., Leghorn, Order; 2,280 bg. burnt, Larnaca, Irving Bank-Col. Trust Co.; 1,450 bg., Larnaca, Imperial Ottoman Bank; 600 bg., Larnaca, J. L. Smith & Co.

VALONEA—4,424 bg., Dardanelles, E. A. Benadava; 6,482 bg., Dardanelles, J. A. Barkey & Co.; 950 bg., Constantinople, A. Benadava.

WAXES—7 bg. beeswax, Santo Domingo, W. Schall & Co.; 30 cs. beeswax, St. Nazaire, Order; 450 cs. vegetable, Kobe, National City Bank; 99 bg. beeswax, Antwerp, Strohmeyer & Arpe; 90 pkg. do., Antwerp, Strahl & Pitsch; 218 bg. beeswax, Rio de Janeiro, American Trading Co.

WHITING—1,000 bg., Antwerp, Bankers Trust Co.

WOLFRAMITE—606 dr. ferro, Rotterdam, Order.

WOOL GREASE—30 bbl., Bremen, Pfaltz & Bauer; 50 csk., Bremen, Pfaltz & Bauer.

ZINC OXIDE—200 bbl., Antwerp, Brown Bros. & Co.

ZINC WHITE—60 csk., Havre, Order; 53 csk., Rotterdam, Roessler & Hasslacher Chem. Co.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetone, drums, wks.	lb.	$0.15 -	$0.15½
Acetic anhydride, 85%, dr.	lb.	.34 -	.36
Acid, acetic, 28%, bbl.	100 lb.	3.12 -	3.37
Acetic, 56%, bbl.	100 lb.	5.85 -	6.10
Acetic, 80%, bbl.	100 lb.	8.19 -	8.44
Glacial, 99½%, bbl.	100 lb.	11.01 -	11.51
Boric, bbl.	lb.	.09 -	.09½
Citric, kegs	lb.	.46 -	.46½
Formic, 85%	lb.	.12½ -	.13
Gallic, tech.	lb.	.45 -	.50
Hydrofluoric, 52%, carboys	lb.	.11 -	.12
Lactic, 44%, tech., light, bbl.	lb.	.12½ -	.13
22% tech., light, bbl.	lb.	.06 -	.06½
Muriatic, 18° tanks	100 lb.	.80 -	.85
Muriatic, 20°, tanks	100 lb.	.95 -	1.00
Nitric, 36°, carboys	lb.	.04 -	.04½
Nitric, 42°, carboys	lb.	.04½ -	.05½
Oleum, 20%, tanks	ton	16.00 -	17.00
Oxalic, crystals, bbl.	lb.	.09½ -	.10
Phosphoric, 50% carboys	lb.	.07 -	.08
Pyrogallic, resublimed	lb.	1.55 -	1.60
Sulphuric, 60°, tanks	ton	8.00 -	9.00
Sulphuric, 60°, drums	ton	12.00 -	13.00
Sulphuric, 66°, tanks	ton	13.00 -	14.00
Sulphuric, 66° drums	ton	17.00 -	18.00
Tannic, U.S.P., bbl.	lb.	.65 -	.70
Tannic, tech., bbl.	lb.	.45 -	.50
Tartaric, imp., powd., bbl.	lb.	.27 -	.28
Tartaric, domestic, bbl.	lb.	.30 -	....
Tungstic, per lb.	lb.	1.20 -	1.25
Alcohol, butyl, drums, f.o.b. works	lb.	.25 -	.30
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.83 -	....
Ethyl, 190 p'f. U.S.P., bbl.	gal.	4.81 -	....
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 190 proof			
No. 1, special bbl.	gal.	.49 -	...
No. 1, 190 proof, special, dr.	gal.	.43 -	...
No. 1, 188 proof, bbl.	gal.	.52 -	...
No. 1, 188 proof, dr.	gal.	.46 -	...
No. 5, 188 proof, bbl.	gal.	.48 -	...
No. 5, 188 proof, dr.	gal.	.42 -	...
Alum, ammonia, lump, bbl.	lb.	.03½ -	.04
Potash, lump, bbl.	lb.	.02¾ -	.03½
Chrome, lump, potash, bbl.	lb.	.05½ -	.06
Aluminum sulphate, com., bags	100 lb.	1.35 -	1.40
Iron free bags	lb.	2.35 -	2.45
Aqua ammonia, 26°, drums	lb.	.06½ -	.06¾
Ammonia, anhydrous, cyl.	lb.	.28 -	.30
Ammonium carbonate, powd. tech., casks	lb.	.12 -	.13
Ammonium nitrate, tech., casks	lb.	.09 -	.10
Amyl acetate tech., drums	gal.	2.50 -	2.60
Antimony oxide, white, bbl.	lb.	.10 -	.10½
Arsenic, white, powd., bbl.	lb.	.07½ -	.08
Arsenic, red, powd., kegs	lb.	.14½ -	.15½
Barium carbonate, bbl.	ton	60.00 -	61.00
Barium chloride, bbl.	ton	78.00 -	79.00
Barium dioxide, 88%, drums	lb.	.17½ -	.18
Barium nitrate, casks		.08½ -	.08¾
Blanc fixe, dry, bbl.	lb.	.03¾ -	.04
Bleaching powder, f.o.b. wks., drums	100 lb.	1.90 -	....
Spot N. Y. drums	100 lb.	2.20 -	2.25
Borax, bbl.	lb.	.05 -	.05½
Bromine, cases	lb.	.34 -	.38
Calcium acetate, bags	100 lb.	3.00 -	3.05
Calcium arsenate, dr.	lb.	.09 -	.09½
Calcium carbide, drums	lb.	.05 -	.05½
Calcium chloride, fused, dr. wks.	ton	21.00 -	....
Gran. drums works	ton	27.00 -	....
Calcium phosphate, mono, bbl.	lb.	.06½ -	.07½
Camphor, Jap. cases	lb.	.71 -	.72
Carbon bisulphide, drums	lb.	.06 -	.06½
Carbon tetrachloride, drums	lb.	.07 -	.07½
Chalk, precip.—domestic, light, bbl.	lb.	.04½ -	.04½
Domestic, heavy, bbl.	lb.	.03½ -	.04
Imported, light, bbl.	lb.	.04½ -	.05
Chlorine, liquid, tanks, wks.	lb.	.04½ -	....
Contract, tanks, wks.	lb.	.04½ -	....
Cylinders, 100 lb., wks.	lb.	.05½ -	.07½
Chloroform, tech., drums	lb.	.30 -	.32
Cobalt, oxide, bbl.	lb.	2.10 -	2.25
Copperas, bulk, f.o.b. wks.	ton	15.00 -	16.00
Copper carbonate, bbl.	lb.	.15½ -	.16
Copper cyanide, drums	lb.	.45 -	.46
Coppersulphate, dom., bbl.	100 lb.	4.30 -	4.40
Imp bbl.	100 lb.	4.12½ -	4.20
Cream of tartar, bbl.	lb.	.20½ -	.21
Epsom salt, dom., tech., bbl.	100 lb.	1.75 -	2.00
Epsom salt, imp., tech., bags	100 lb.	1.35 -	1.40
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.10 -	2.35
Ether, U.S.P., dr concent'd	lb.	.13 -	.14
Ethyl acetate, 85%, drums	gal.	.92 -	.95
Ethyl acetate, 99%, dr.	gal.	$1.08 -	$1.10
Formaldehyde, 40%, bbl.	lb.	.09 -	.09½
Fullers earth—f.o.b. mines	ton	7.50 -	18.00
Furfural, works, bbl.	lb.	.25 -	....
Fusel oil, ref., drums	gal.	2.75 -	3.50
Fusel oil, crude, drums	gal.	1.50 -	1.75
Glaubers salt, wks., bags	100 lb.	1.20 -	1.40
Glaubers salt, imp., bags	100 lb.	.90 -	.92
Glycerine, c.p., drums extra	lb.	.17 -	.17½
Glycerine, dynamite, drums	lb.	.16½ -	....
Glycerine, crude 80%, loose	lb.	.10¾ -	.11
Hexamethylene, drums	lb.	.65 -	.70
Lead:			
White, basic carbonate, dry, casks	lb.	.09¾ -	....
White, basic sulphate, casks	lb.	.09½ -	....
White, in oil, kegs	lb.	.11¾ -	.12½
Red, dry, casks	lb.	.10½ -	....
Red, in oil, kegs	lb.	.12¾ -	.13½
Lead acetate, white crys., bbl.	lb.	.14½ -	....
Brown, broken, casks	lb.	.13½ -	....
Lead arsenate, powd., bbl.	lb.	.16 -	.18
Lime-Hydrated, bg, wks.	ton	10.50 -	12.50
Bbl., wks.	ton	18.00 -	19.00
Lime, Lump, bbl.	280 lb.	3.63 -	3.65
Litharge, comm., casks	lb.	.10 -	.10½
Lithopone, bags	lb.	.06½ -	.06¾
Magnesium carb., tech., bags	lb.	.08½ -	.08¾
Methanol, 95%, bbl.	gal.	.74 -	.76
Methanol, 97%, bbl.	gal.	.76 -	.78
Methanol, pure, tanks	gal.	.75 -	....
drums	gal.	.78 -	.80
bbl.	gal.	.83 -	.85
Methyl-acetone, t'ks.	gal.	.70 -	....
Nickel salt, double, bbl.	lb.	.09 -	.10½
Nickel salts, single, bbl.	lb.	.10 -	.11
Orange mineral, csk.	lb.	.13½ -	.14½
Phosgene	....	.60 -	.75
Phosphorus, red, cases	lb.	.70 -	.75
Phosphorus, yellow, cases	lb.	.37½ -	.40
Potassium bichromate, casks	lb.	.09 -	.09½
Potassium bromide, gran., bbl.	lb.	.22 -	.38
Potassium carbonate, 80-85%, calcined, casks	lb.	.05½ -	.05¾
Potassium chlorate, powd.	lb.	.07½ -	.08½
Potassium cyanide, drums	lb.	.47 -	.52
Potassium, first sorts, cask	lb.	.07½ -	.08
Potassium hydroxide (caustic potash) drums	lb.	.06½ -	.06¾
Potassium iodide, cases	lb.	3.65 -	3.75
Potassium nitrate, bbl.	lb.	.06 -	.07½
Potassium permanganate, drums	lb.	.13½ -	.14
Potassium prussiate, red, casks	lb.	.35 -	.38
Potassium prussiate, yellow, casks	lb.	.18½ -	.....
Salammoniac, white, gran., casks, imported	lb.	.06¼ -	.06½
Salammoniac, white, gran., bbl., domestic	lb.	.07½ -	.08
Gray, gran., casks	lb.	.08 -	.09
Salsoda, bbl.	100 lb.	1.20	1.40
Salt cake (bulk) works	ton	16.00 -	18.00
Soda ash, light, 58% flat, bulk, contract	100 lb.	1.25 -	....
bags, contract	100 lb.	1.38 -	....
Soda ash, dense, bulk, contract, basis 58%	100 lb.	1.35 -	....
bags, contract	100 lb.	1.45 -	....
Soda, caustic, 76%, solid, drums contract	100 lb.	3.10 -	....
Soda, caustic, ground and flake, contracts, dr.	100 lb.	3.50 -	3.85
Soda, caustic, solid, 76% f. a. s. N. Y.	100 lb.	2.90 -	3.05
Sodium acetate, works, bbl.	lb.	.04½ -	.05
Sodium bicarbonate, bulk	100 lb.	1.75 -	....
330-lb. bbl.	100 lb.	2.00 -	....
Sodium bichromate, casks	lb.	.07½ -	.07¾
Sodium bisulphate (niter cake)	ton	6.00 -	7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½ -	.04½
Sodium chlorate, kegs	lb.	.06½ -	.07
Sodium chloride	long ton	12.00 -	13.00
Sodium cyanide, cases	lb.	.19 -	.22
Sodium fluoride, bbl.	lb.	$0.08½ -	$0.10
Sodium hyposulphite, bbl.	lb.	.02½ -	.02
Sodium nitrite, casks	lb.	.08¾ -	.09
Sodium peroxide, powd., cases	lb.	.23 -	.27
Sodium phosphate, dibasic, bbl.	lb.	.03½ -	.03¾
Sodium prussiate, yel. bbl.	lb.	.09½ -	.10½
Sodium salicylic, drums	lb.	.38 -	.40
Sodium silicate (40°, drums)	100 lb.	.75 -	1.15
Sodium silicate (60°, drums)	100 lb.	1.75 -	2.00
Sodium sulphide, fused, 60-62% drums	lb.	.03½ -	.03½
Sodium sulphite, crys., bbl.	lb.	.02½ -	.03
Strontium nitrate, powd., bbl.	lb.	.09½ -	.10
Sulphur chloride, yel drums.	lb.	.04½ -	.05
Sulphur, crude	ton	18.00 -	20.00
At mine, bulk	ton	16.00 -	18.00
Sulphur, flour, bag	100 lb.	2.25 -	2.35
Sulphur, roll, bag	100 lb.	2.00 -	2.10
Sulphur dioxide, liquid, cyl.	lb.	.08 -	.08
Tin bichloride, bbl.	lb.	.12¾ -	.....
Tin oxide, bbl.	lb.	.48 -	.....
Tin crystals, bbl.	lb.	.33 -	.....
Zinc carbonate, bags	lb.	.12 -	.14
Zinc chloride, gran, bbl.	lb.	.06 -	.07½
Zinc cyanide, drums	lb.	.36½ -	.37
Zinc dust, bbl.	lb.	.08 -	.08½
Zinc oxide, lead free, bag	lb.	.07½ -	.....
5% lead sulphate bags	lb.	.06¾ -	.....
10 to 35 % lead sulphate, bags	lb.	.06¾ -	......
French, red seal, bags	lb.	.09¾ -	......
French, green seal, bags	lb.	.10¾ -	......
French, white seal, bbl.	lb.	.11¾ -	......
Zinc sulphate, bbl.	100 lb.	3.00 -	3.25

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.60 -	$0.65
Alpha-naphthol, ref., bbl.	lb.	.65 -	.75
Alpha-naphthylamine, bbl.	lb.	.35 -	.36
Aniline oil, drums	lb.	.16 -	.16½
Aniline salt, bbl.	lb.	.22 -	.23
Anthracene, 80%, drums	lb.	.70 -	.75
Anthraquinone, 25%, paste, drums	lb.	.75 -	.80
Benzaldehyde U.S.P., carboys	lb.	1.50 -	.....
f.f.c. drums	lb.	1.60 -	.....
tech, drums	lb.	68	.72
Benzene, pure, water-white, tanks, works	gal.	.25 -	....
Benzene, 90%, tanks, works	gal.	.23 -	....
Benzidine base, bbl.	lb.	.80 -	.82
Benzidine sulphate, bbl.	lb.	.70 -	.72
Benzoic acid, U.S.P., kegs	lb.	.75 -	85
Benzoate of soda, U.S.P., bbl.	lb.	.65 -	.70
Benzyl chloride, 95-97%, ref. carboys	lb.	.35 -	....
Benzyl chloride, tech., drums	lb.	.25 -	....
Beta-naphthol, tech., bbl.	lb.	.24 -	.25
Beta-naphthylamine, tech.	lb.	.65 -	.70
Cresol, U.S.P., drums	lb.	.22 -	.26
Ortho-cresol, drums	lb.	.28 -	.32
Cresylic acid, 97%, works drums	gal.	.63 -	.67
95-97%, drums, works	gal.	.58 -	.61
Dichlorbenzene, drums	lb.	.07 -	.08
Diethylaniline, drums	lb.	.53 -	.58
Dimethylaniline, drums	lb.	.35 -	.37
Dinitrobenzene, bbl.	lb.	.15 -	.17
Dinitrochlorbenzene, bbl.	lb.	.21 -	.22
Dinitronaphthalen, bbl.	lb.	.30 -	.32
Dinitrophenol, bbl.	lb.	.35 -	.40
Dinitrotoluen, bbl.	lb.	.18 -	.20
Dip oil, 25%, drums	gal.	.26 -	.28
Diphenylamine, bbl.	lb.	.48 -	.50
H-acid, bbl.	lb.	.72 -	.75
Meta-phenylenediamine, bbl.	lb.	.95 -	1.00
Michlers ketone, bbl.	lb.	3.00 -	3.25
Monochlorbenzene, drums	lb.	.08 -	.10
Monoethylaniline, drums	lb.	1.20 -	1.30
Naphthalene, flake, bbl.	lb.	.04¾ -	.05¼
Naphthalene, balls, bbl.	lb.	.05½ -	.05¾
Naphthionate of soda, bbl.	lb.	.60 -	.65
Naphthionic acid, crude, bbl.	lb.	.60 -	.62
Nitrobenzene, drums	lb.	.09 -	.09½
Nitro-naphthalene, bbl.	lb.	.25 -	.30
Nitro-toluene, drums	lb.	.13½ -	.14
N-W acid, bbl.	lb.	.95 -	1.00
Ortho-amidophenol, kegs	lb.	2.40 -	2.50
Ortho-dichlorbenzene, drums	lb.	.12 -	.13
Ortho-nitrophenol, bbl.	lb.	.95 -	1.00
Ortho-nitrotoluene, drums	lb.	.11 -	.12
Ortho-toluidine, bbl.	lb.	.12 -	.13
Para-aminophenol, base, kegs	lb.	1.20 -	1.25
Para-aminophenol, HCl, kegs	lb.	1.30 -	1.40
Para-dichlorbenzene, bbl.	lb.	.17 -	.20
Paranitraniline, bbl.	lb.	.68 -	.70
Para-nitrotoluene, bbl.	lb.	.50 -	.55
Para-phenylenediamine, bbl.	lb.	1.35 -	1.45
Para-toluidine, bbl.	lb.	.72 -	.80
Phthalic anhydride, bbl.	lb.	.30 -	.34
Phenol, U.S.P., dr.	lb.	.24 -	.26
Picric acid, bbl.	lb.	.20 -	22
Pitch, tanks, works	ton	25.00 -	30.00
Pyridine, imp., drums	gal.	3.70 -	3.80
Resorcinol, tech., kegs	lb.	1.30 -	1.40

Resorcinol, pure, kegs	lb.	$2.00 - $2.25
R-salt, bbl	lb.	.50 - .55
Salicylic acid tech., bbl	lb.	.32 - .33
Salicylic acid, U.S.P., bbl	lb.	.35 - ....
Solvent naphtha, water-white, tanks	gal.	.25 - ....
Crude, tanks	gal.	.22 - ....
Sulphanilic acid, crude, bbl	lb.	.16 - .18
Tolidine, bbl	lb.	1.00 - 1.05
Toluidine, mixed, kegs	lb.	.30 - .35
Toluene, tank cars, works	gal.	.26 - ....
Toluene, drums, works	gal.	.30 - ....
Xylidine, drums	lb.	.45 - .48
Xylene, 5 deg.-tanks	gal.	.40 - ....
Xylene, com., tanks	gal.	.28 - ....

Naval Stores

Rosin B-D, bbl	280 lb.	$5.60 - $5.65
Rosin E-I, bbl	280 lb.	5.70 - 5.75
Rosin K-N, bbl	280 lb.	5.95 - 6.20
Rosin W.G.-W.W., bbl	280 lb.	7.00 - 7.60
Wood rosin, bbl	280 lb.	5.40 - 5.50
Turpentine, spirits of, bbl	gal.	.83 - ....
Wood, steam dist., bbl	gal.	.72 - ....
Wood, dest. dist., bbl	gal.	.54 - .55
Pine tar pitch, bbl	200 lb.	5.50 - ....
Tar, kiln burned, bbl	500 lb.	10.50 - ....
Retort tar, bbl	500 lb.	10.50 - ....
Rosin oil, first run, bbl	gal.	.38 - ....
Rosin oil, second run, bbl	gal.	.43 - ....
Rosin oil, third run, bbl	gal.	.48 - ....
Pine oil, steam dist.	gal.	.60 - ....
Pine tar oil, com'l	gal.	.30 - ....

Animal Oils and Fats

Degras, bbl	lb.	$0.03½ - $0.05½
Grease, yellow, loose	lb.	.07½ - .07¾
Lard oil, Extra No. 1, bbl	gal.	.83 - .84
Lard compound, bbl	lb.	.14½ - .14¾
Neatsfoot oil 20 deg. bbl	gal.	1.26 - ....
No. 1, bbl	gal.	.82 - .84
Oleo Stearine		.14 - ....
Oleo oil, No. 1, bbl	lb.	.14½ - ....
Red oil, distilled, d.p. bbl	lb.	.08½ - .09
Saponified, bbl	lb.	.08½ - .09
Tallow, extra, loose works	lb.	.07½ - ....
Tallow oil, acidless, bbl	gal.	.82½ - .83½

Vegetable Oils

Castor oil, No. 3, bbl	lb.	$0.16 - ....
Castor oil, No. 1, bbl	lb.	.16½ - ....
Chinawood oil, bbl	lb.	.14½ - .15½
Coconut oil, Ceylon, bbl	lb.	.09½ - .10
Ceylon, tanks, N.Y.	lb.	.09 - ....
Coconut oil, Cochin, bbl	lb.	.10½ - ....
Corn oil, crude, bbl	lb.	.12½ - .12¾
Crude, tanks, (f.o.b. mill)	lb.	.11 - ....
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.10½ - 11
Summer yellow, bbl	lb.	.13 - ....
Winter yellow, bbl	lb.	.14½ - .15
Linseed oil, raw, car lots, bbl.	gal.	.98 - ....
Raw, tank cars (dom.)	gal.	.92 - ....
Boiled, cars, bbl. (dom.)	gal.	1.00 - ....
Olive oil, denatured, bbl	gal.	1.15 - 1.20
Sulphur, (foots) bbl	lb.	.09½ - .09¾
Palm, Lagos, casks	lb.	.08 - .08¼
Niger, casks	lb.	.07½ - .07¾
Palm kernel, bbl	lb.	.09½ - ....
Peanut oil, crude, tanks (mill)	lb	.12 - ....
Peanut oil, refined, bbl	lb.	.15 - ....
Perilla, bbl	lb.	.13 - .13½
Rapeseed oil, refined, bbl	gal.	.81 - .83
Sesame, bbl	lb.	.12½ - .12¾
Soya bean (Manchurian), bbl.	lb.	.11½ - .11¾
Tank, f.o.b. Pacific coast	lb.	.10½ - ....
Tank, (f.o.b. N.Y.)	lb.	.10¾ - ....

Fish Oils

Cod, Newfoundland, bbl	gal.	$0.58 - $0.60
Menhaden, light pressed, bbl.	gal.	.54 - ....
White bleached, bbl	gal.	.56 - ....
Blown, bbl	gal.	.60 - ....
Crude, tanks (f.o.b. factory)	gal.	.40 - .45
Whale No. 1 crude, tanks, coast	lb.	....
Winter, natural, bbl	gal.	.75 - .76
Winter, bleached, bbl	gal.	.78 - .79

Oil Cake and Meal

Coconut cake, bags	ton	$32.00 - ....
Cottonseed meal, f.o.b. mills	ton	42.00 - 43.00
Linseed cake, bags	ton	43.00 - 44.00
Linseed meal, bags, spot	ton	45.00 - 46.00

Dye & Tanning Materials

Albumen, blood, bbl	lb.	$0.50 - $0.55
Albumen, egg, tech, kegs	lb.	.95 - .97
Cochineal, bags	lb.	.33 - .35
Cutch, Borneo, bales	lb.	.04½ - .04¾
Cutch, Rangoon, bales	lb.	.13½ - .14½
Dextrine, corn, bags	100 lb.	4.32 - 4.37
Dextrine gum, bags	100 lb.	4.62 - 4.89
Divi-divi, bags	ton	40.00 - 42.00
Fustic, sticks	ton	30.00 - 35.00
Fustic, chips, bags	lb.	.04 - .05
Gambier com., bags	lb.	.12 - .13
Logwood, sticks	ton	25.00 - 26.00
Logwood, chips, bags	lb.	.02½ - .03
Sumac, leaves, Sicily, bags	ton	165.00 - 170.00
Sumac, ground, bags	ton	155.00 - 160.00
Sumac, domestic, bags	ton	50.00 - 55.00
Starch, corn, bags	100 lb.	3.67 - 3.94
Tapioca flour, bags	lb.	.04½ - .06

Extracts

Archil, conc., bbl	lb.	$0.16 - $0.19
Chestnut, 25% tannin, tanks	lb.	.01½ - .02
Divi-divi, 25% tannin, bbl	lb.	.04½ - .05½
Fustic, crystals, bbl	lb.	.20 - .22
Fustic, liquid, 42°, bbl	lb.	.08 - .09
Gambier, liq., 25% tannin, bbl.	lb.	.11 - .11½
Hematine crys., bbl	lb.	.14 - .18
Hemlock, 25% tannin, bbl	lb.	.03½ - .04
Hypernic, solid, drums	lb.	.22 - .24
Hypernic, liquid, 51°, bbl	lb.	.12 - .13
Logwood, crys., bbl	lb.	.14 - .15
Logwood, liq., 51°, bbl	lb.	.07½ - .08½
Osage Orange, 51°, liquid, bbl.	lb.	.07 - .08
Osage Orange, powder, bg.	lb.	.14 - .15
Quebracho, solid, 65% tannin, bbl	lb.	.04½ - .04¾
Sumac, dom., 51°, bbl	lb.	.06½ - .07

Dry Colors

Blacks-Carbongas, bags, f.o.b. works, contract	lb.	$0.09 - $0.11
spot, cases	lb.	.12 - .16
Lampblack, bbl	lb.	.12 - .40
Mineral, bulk	ton	35.00 - 45.00
Blues-Bronze, bbl	lb.	.38 - .40
Prussian, bbl	lb.	.38 - .40
Ultramarine, bbl	lb.	.08 - .35
Browns, Sienna, Ital., bbl	lb.	.06 - .14
Sienna, Domestic, bbl	lb.	.03½ - .04
Umber, Turkey, bbl	lb.	.04 - .04½
Greens-Chrome, C.P. Light, bbl	lb.	.28 - .30
Chrome, commercial, bbl	lb.	.11½ - .12
Paris, bulk	lb.	.24 - .26
Reds, Carmine No. 40, tins	lb.	4.25 - 4.50
Iron oxide red, casks	lb.	.08 - .12
Para toner, kegs	lb.	.95 - 1.00
Vermilion, English, bbl	lb.	1.25 - 1.30
Yellow, Chrome, C.P. bbls	lb.	.17 - .17½
Ocher, French, casks	lb.	.02½ - .03

Waxes

Bayberry, bbl	lb.	$0.21 - $0.21½
Beeswax, crude, Afr. bg.	lb.	.25½ - .26½
Beeswax, refined, light, bags	lb.	.32 - .34
Beeswax, pure white, cases	lb.	.40 - .41
Candellila, bags	lb.	.23 - .23½
Carnauba, No. 1, bags	lb.	.39 - .40
No. 2, North Country, bags	lb.	.28 - .29
No. 3, North Country, bags	lb.	.21 - .22
Japan, cases	lb.	.20½ - .21
Montan, crude, bags	lb.	.05¾ - .06
Paraffine, crude, match, 105-110 m.p., bbl	lb.	.05 - .05½
Crude, scale 124-126 m.p. bags	lb.	.04½ - ....
Ref., 118-120 m.p., bags	lb.	.05 - ....
Ref., 123-125 m.p., bags	lb.	.05¼ - ....
Ref., 128-130 m.p., bags	lb.	.05½ - .05¾
Ref., 133-135 m.p., bags	lb.	.06¾ - .07
Ref., 135-137 m.p., bags	lb.	.07¼ - .07½
Stearic acid, sgle pressed, bags	lb.	.10¼ - ....
Double pressed, bags	lb.	.11¼ - ....
Triple pressed, bags	lb.	.12½ - ....

Fertilizers

Acid phosphate, 16%, bulk, works	ton	$7.50 - $7.75
Ammonium sulphate, bulk f.o.b. works	100 lb.	2.50 - ....
Blood, dried, bulk	unit	4.10 - 4.15
Bone, raw, 3 and 50, ground	ton	26.00 - 28.00
Fish scrap, dom., dried, wks.	unit	3.25 - ....
Nitrate of soda, bags	100 lb.	2.45 - ....
Tankage, high grade, f.o.b. Chicago	unit	2.50 - ....
Phosphate rock, f.o.b. mines		
Florida pebble, 68-72%	ton	3.25 - 3.70
Tennessee, 75%	ton	6.75 - 7.00
Potassium muriate, 80%, bags	ton	34.55 - ....
Potassium sulphate, bags basis 90%	ton	45.85 - ....
Double manure salt	ton	26.35 - ....
Kainit	ton	7.22 - ....

Crude Rubber

Para—Upriver fine	lb.	$0.22¾ - ....
Upriver coarse	lb.	.15 - ....
Upriver caucho ball	lb.	.14¾ - .15
Plantation—First latex crepe	lb.	.23¾ - ....
Ribbed smoked sheets	lb.	.22¾ - ....
Amber crepe No. 1	lb.	.22¾ - ....

Gums

Copal, Congo, amber, bags	lb.	$0.09 - $0.14
East Indian, bold, bags	lb.	.13 - .14
Manila, pale, bags	lb.	.18 - .19
Pontinak, No. 1 bags	lb.	.19 - .20
Damar, Batavia, cases	lb.	.23 - .23½
Singapore, No. 1, cases	lb.	.27 - .27½
Singapore, No. 2, cases	lb.	.18½ - .19
Kauri, No. 1, cases	lb	.58 - .64
Ordinary chips, cases	lb.	.21 - .22
Manjak, Barbados, bags	lb.	.06 - .09

Shellac

Shellac, orange fine, bags	lb.	$0.54 - $0.55
Orange superfine, bags	lb.	.56 - .57
A. C. garnet, bags	lb.	.52 - ....
Bleached, bonedry	lb.	.63 - .64
Bleached, fresh	lb.	.52 - .53
T. N., bags	lb.	.52 - .53

Miscellaneous Materials

Asbestos, crude No. 1 f.o.b., Quebec	sh. ton	$300.00 - $400.00
Asbestos, shingle, f.o.b. Quebec	sh. ton	50.00 - 70.00
Asbestos, cement, f.o.b., Quebec	sh. ton	20.00 - 25.00
Barytes, grd., white, f.o.b. mills, bbl	net ton	16.00 - 17.00
Barytes, grd., off-color, f.o.b. Balt.	net ton	13.00 - 14.00
Barytes, floated, f.o.b. St. Louis, bbl	net ton	23.00 - 24.00
Barytes, crude f.o.b. mines, bulk	net ton	8.00 - 9.00
Casein, bbl., tech	lb.	.10½ - .12
China clay (kaolin) crude, No. 1, f.o.b. Ga.	net ton	7.00 - 8.00
Washed, f.o.b. Ga.	net ton	8.50 - 9.00
Powd., f.o.b. Ga.	net ton	14.00 - 20.00
Crude f.o.b. Va.	net ton	6.00 - 8.00
Ground, f.o.b. Va.	net ton	13.00 - 19.00
Imp., lump, bulk	net ton	15.00 - 20.00
Imp., powd.	net ton	45.00 - 50.00
Feldspar, No. 1 f.o.b. N.C.	long ton	7.00 - 7.50
No. 2 f.o.b. N.C.	long ton	4.50 - 5.00
No. 1 gr'd. N. C.	long ton	15.32 - 21.00
No. 1 Canadian, f.o.b. mill, powd.	long ton	20.00 - ....
Graphite, Ceylon, lump, first quality, bbl	lb.	.05½ - .06
Ceylon, chip, bbl.	lb.	.04½ - .05
High grade amorphous crude	ton	15.00 - 35.00
Gum arabic, amber, sorts, bags	lb.	.11½ - .11¾
Gum tragacanth, sorts, bags	lb.	.50 - .51
No. 1, bags	lb.	1.20 - ....
Kieselguhr, f.o.b. Cal.	ton	40.00 - 42.00
F.o.b. N. Y.	ton	50.00 - 55.00
Magnesite, calcined, f.o.b. Cal.	ton	35.00 - 45.00
Pumice stone, imp., casks	lb.	.03 - .40
Dom., lump, bbl.	lb.	.06 - .08
Dom., ground, bbl.	lb.	.03 - .05
Silica, glass sand, f.o.b. Ind.	ton	2.00 - 2.50
Silica, sand blast, f.o.b. Ind.	ton	2.25 3.50
Silica, amorphous, 200-mesh, f.o.b. Ill.	ton	20.00 - ....
Silica, glass sand, f.o.b. Ill.	ton	2.00 - 2.50
Soapstone, coarse, f.o.b. Vt., bags	ton	7.50 - 8.00
Talc, 200 mesh, f.o.b., Vt., bags, extra	ton	10.50 - ....
Talc, 200 mesh, f.o.b. Ga., bags	ton	8.00 - 10.00
Talc, 325 mesh, f.o.b. New York, grade A bags	ton	14.75 - ....

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$3.00 - $3.25
Corning	bbl.	1.80 - ......
Cabell	bbl.	1.60 - ......
Somerset	bbl.	1.70 - ......
Illinois	bbl.	1.97 - ......
Indiana	bbl.	1.98 - ......
Kansas and Okla. under 28 deg.	bbl.	.90 - ......
California, 35 deg. and up	bbl.	1.40 - ......

Gasoline, Etc.

Motor gasoline, steel bbls	gal.	$0.19 - ......
Naphtha, V. M. & P. deod, steel bbls	gal	.18 - ......
Kerosene, ref. tank wagon	gal.	.13 - ......
Bulk, W.W. delivered, N.Y.	gal.	.07½ - .07¾
Lubricating oils:		
Cylinder, Penn., filtered	gal.	.30 - .35
Bloomless, 30@31 grav.	gal.	.21 - .22
Paraffin, pale 885 vis.	gal.	.16 - .17
Spindle, 200, pale	gal.	.22 - ......
Petrolatum, amber, bbls.	lb.	.04 - .04½
Paraffine wax (see waxes)		

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	1,000	$140-$145
Chrome brick, f.o.b. Eastern shipping points	ton	45-47
Chrome cement, 40-50% Cr_2O_3	ton	23-27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40-43
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	33-38
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65-68
9-in. arches, wedges and keys	ton	80-85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48-50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48-50
F.o.b. Mt. Union, Pa.	1,000	36-38
Silicon carbide refract. brick, 9-in.	1,000	1,180.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 - ......

Ferrochromium, per lb. of Cr, 1-2% C	lb.	$0.30	....
4-6% C	lb.	.11½	....
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	105.00	....
Spiegeleisen, 19-21% Mn	gr. ton	35.00	36.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	2.00	2.25
Ferrosilicon, 10-12%	gr. ton	39.50	43.50
50%	gr. ton	75.00	.....
Ferrotungsten, 70-80%, per lb. of W	lb.	.90	.93
Ferro-uranium, 35-50%, of U, per lb. of U	lb.	4.50	....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50	4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$5.50	$8.75
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00	....
C.i.f. Atlantic seaboard	ton	19.00	23.00
Coke, fdry., f.o.b. ovens	ton	4.25	4.50
Coke, furnace, f.o.b. ovens	ton	3.00	3.25
Fluorspar, gravel, f.o.b. mines, Illinois	ton	23.50	....
Ilmenite, 52% TiO_2 Va.	lb.	.01½	....
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.42	.46
Manganese ore, chemical (MnO_2)	ton	75.00	80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.80	....
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06	.08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½	.12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½	.12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12	....
Rutile, 94@96% TiO_2	lb.	.12	.15
Tungsten, scheelite, 60% WO_3 and over	unit	9.25	....
Tungsten, wolframite, 60% WO_3	unit	9.00	9.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50	3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	12.25	2.50
Vanadium pent oxide, 99%	lb.	2.00	14.00
Vanadium ore, per lb. V_2O_5	lb.	1.00	1.25
Zircon, 99%	lb.	.06	.07

Non-Ferrous Metals

Copper, electrolytic	lb.	$0.12½- ......
Aluminum, 98 to 99%	lb	.27 - .28
Antimony, wholesale, Chinese and Japanese	lb.	.08½- .08¾
Nickel, 99%	lb.	.27 - .30
Monel metal, shot and blocks	lb.	.32
Tin, 5-ton lots, Straits	lb.	.48¾
Lead, New York, spot		.07½
Lead, E. St. Louis, spot	lb.	.0690
Zinc, spot, New York	lb.	.0635
Zinc, spot, E. St. Louis	lb.	.06
Silver (commercial)	oz	.67
Cadmium	lb.	.60
Bismuth (500 lb. lots)	lb	2.40
Cobalt	lb.	2.50-3.00
Magnesium, ingots, 99%	lb.	.90-.95
Platinum, refined	oz.	120.00
Iridium	oz.	260.00-270.00
Palladium, refined	oz.	78.00-83.00
Mercury	75 lb.	71.50-72.00
Tungsten powder	lb.	.95-1.00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	18.25
Copper bottoms	28.00
Copper rods	18.75
High brass wire	16.75
High brass rods	14.00
Low brass wire	18.50
Low brass rods	19.50
Brazed bronze tubing	23.75
Seamless copper tubing	21.75
Seamless high brass tubing	20.50

OLD METALS—The following are the dealers purchasing prices in cents per pound

Copper, heavy and crucible	9.50 @ 9.75
Copper, heavy and wire	9.25 @ 9.37½
Copper, light and bottoms	7.50 @ 7.75
Lead, heavy	5.75 @ 5.87½
Lead, tea	3.50 @ 3.62½
Brass, heavy	4.75 @ 5.00
Brass, light	4.00 @ 4.25
No. 1 yellow brass turnings	6.00 @ 6.25
Zinc scrap	3.37½ @ 3.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.44	$3.44
Soft steel bars	3.34	3.34
Soft steel bar shapes	3.54	3.54
Soft steel bands	4.09	4.09
Plates, ¼ to 1 in. thick	3.44	3.44

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Arizona

MIAMI—The Inspiration Consolidated Copper Co. has added to its plans for the construction of its proposed leaching plant and purposes now to build a structure to cost in excess of $2,500,000, instead of an appreciably smaller amount previously noted. It will consist of a number of units, for which foundations will soon be laid. A list of machinery to be installed is being arranged. Thomas H. O'Brien is general manager.

California

SAN FRANCISCO—The Bass-Hueter Paint Co., 2240 24th St., has plans under way for the construction of a new plant on tract of land bounded by De Haro, Mariposa, Kansas and Army Sts., totaling about 3 acres. It is estimated to cost close to $500,000, including equipment, and will be used for the manufacture of paints, oils, varnishes and kindred products. Bids will soon be asked. L. M. du Commun is general manager.

CUDAHY—The California Cyanide Co. is perfecting plans for the construction of a new 1-story addition to its plant, to be equipped for distilling service. A contract for the building has been let to the Union Iron Works, Los Angeles, and work will soon begin.

LOS ANGELES—The Oro Grande Cement Co. is having plans prepared for the construction of a new 1-story mixing plant in the Beverly Hills district, to be 40x100 ft. A list of equipment to be installed is being arranged. A. L. Acker, Douglas Bldg., Los Angeles, is architect.

CROCKETT—The California & Hawaiian Sugar Refining Co., 230 California St., San Francisco, is completing plans for proposed extensions and improvements in its refining and distributing plant at Crockett, and will soon ask bids. The work will include the remodeling of present buildings, erection of new structures, and installation of equipment, with entire cost estimated at approximately $1,500,000. A. A. Brown, 215 Market St., San Francisco, is consulting engineer.

Connecticut

STRATFORD—The Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, has commenced the construction of a new 1-story plant at Stratford, 90x240 ft., to be used for the manufacture of its regular line of abrasive products. It is estimated to cost approximately $40,000. A general building contract has been let to William Muirhead & Son, Bridgeport, V. W. Tarnay, Bridgeport, is architect.

Florida

COCOANUT GROVE—The Red Bird Guano Co., recently organized, has taken over property at Douglas Rd. and Larkin St., for a local plant, and has preliminary plans under advisement for the construction of a 1-story addition, to be equipped as a mixing works. Cornelius Christiancy is president.

ORLANDO—The Pittman-Jones Tile Co., Inc., recently organized, is perfecting plans for the construction of a new 1-story plant for the manufacture of cement and concrete roofing tile, and kindred products. The initial works will cost close to $17,000, and will be extended later. W. S. Pittman is president..

Georgia

COLUMBUS—The Herty Shale Brick & Tile Co., recently organized by officials of the Columbus Brick & Tile Co., as a subsidiary, has acquired two plants in this section heretofore operated under the name of the Herty Turpentine Cup Co., and has plans under way for extensions and improvements, with the installation of additional equipment. The new company will specialize in the manufacture of tile and other pottery products. C. W. Dixon is president, and H. L. Miller, secretary.

Indiana

HARTFORD CITY—The Fort Wayne Corrugated Paper Co., Murray St., Fort Wayne, Ind., has awarded a general contract to the G. W. Heinzemann Sons Construction Co., Marion, Ind., for the erection of its proposed new local plant, to be 1- and 2-story, 180x350 ft., to cost approximately $250,000. Work will be placed in progress at once.

DUNKIRK—The Hart Glass Mfg. Co. has preliminary plans under way for the construction of a 1-story power house at its works.

Iowa

CEDAR RAPIDS—The Churchill Drug Co., W. K. Roth, head, is having plans drawn for the construction of a new plant at 9th Ave. and 2nd St., to be 6-story and basement, 120x140 ft., equipped for the manufacture of drugs, chemicals, chemical compounds, etc., estimated to cost about $250,000. W. J. Brown, Bever Bldg., is architect.

Kentucky

LOUISVILLE—The Winter Paper Stock Co., 1001 Rowan St., is reported to be planning for the rebuilding of the portion of its 4-story works, recently destroyed by fire, with loss estimated at close to $75,000.

Maryland

BALTIMORE—The N. K. Fairbanks Co., 111 West Washington St., Chicago, Ill., manufacturer of soaps, washing compounds, etc., has negotiations under way for the acquisition of property in the Canton district, for the establishment of a new branch plant, with estimated cost reported in excess of $400,000, including equipment. The company is also said to be considering the purchase of the local plant of the Miller Fertilizer Co., to be used in conjunction with the proposed works.

Michigan

DETROIT—The Detroit Grey Iron Foundry Co., Wight and Iron Sts., is taking bids on a general contract for the construction of a new 1-story foundry, 50x80 ft., on Wight St., estimated to cost about $25,000. Mildrier & Eisen, Hammond Bldg., are architects. H. H. Wyatt is secretary.

Mississippi

PASCAGOULA—Charles T. Elliott, 153 Dean Rd., Brookline, Mass., is reported to have organization plans in progress for a new company to construct and operate a plant in this vicinity for the manufacture of paper products, to consist of a number of units estimated to cost close to $150,000, with equipment. The new company will be capitalized at $500,000.

New Jersey

PORT MURRAY—The National Fireproofing Co., Fulton Bldg., Pittsburgh, Pa., manufacturer of hollow tile building products, etc., has plans maturing for the construction of an addition to its plant at Port Murray, including improvements in present buildings, and installation of additional equipment. It is purposed to ask bids at an early date.

TRENTON—The Essex Rubber Co., Beakes and May Sts., manufacturer of moulded mechanical rubber goods, etc., plans for expansion at its plant, to include additional buildings and equipment. The company will use a portion of a bond issue of $400,000, now being sold, for the work.

GILLESPIE—The Dayton Mahogany Corp., 202 Lewis St., New York, has plans under way for a new ammonium nitrate works at Gillespie, Middlesex County. The work will consist of remodeling and installing necessary equipment in the present plant of the Evans Engineering Co., at this place, in which a substantial interest is held. The company has made application to the County Board of Freeholders for permission to carry out the project.

CAMDEN—J. Eavenson & Sons, Inc., Delaware Ave. and Penn St., manufacturer of soaps, alkalis, powders, etc., has awarded

a general building contract to Henry P. Friend, Boyer Arcade, Norristown, Pa., for the rebuilding of the portion of its 3-story plant, 45x130 ft., estimated to cost approximately $45,000. Former equipment will be replaced. C. W. Becker is president.

JERSEY CITY—Colgate & Co., 105 Hudson St., manufacturer of soaps, and kindred products, is reported to be considering the construction of a new plant at Vera Cruz, Mex., consisting of a multi-story building, to cost in excess of $500,000, with machinery.

New York

TOTTENVILLE, S. I.—The Tottenville Copper Co. has plans for the immediate construction of a 1-story foundry, on Bedel Ave., for which a building permit has been issued.

ROCHESTER—The Eastman Kodak Co., Kodak Park, has awarded a general contract to the Ridge Construction Co., 335 Lewiston Ave., for the erection of a 4-story addition, 40x52 ft., a portion of the structure to be equipped as a laboratory. Work will be placed under way at once.

NEW YORK—The Electro-Chemical Laboratory, Inc., has leased a floor in the building at 417 East 22nd St., for a local works.

Ohio

GERMANTOWN—The Ohio Portland Cement Co., Germantown, near Dayton, recently organized, is said to be arranging for the immediate construction of a new plant on local site, to consist of six buildings, three kilns and auxiliary structures, including power house, estimated to cost more than $1,200,000 with equipment. Contract for the initial unit has been let to the Bellefontaine Bridge & Steel Co., Bellefontaine, O., and other awards will be made at an early date. Edward Ballard, West Baden, Ind., is one of the heads of the new company.

Oklahoma

STROUD—The Stroud Gasoline Co., recently organized with a capital of $250,000, has acquired a local gasoline-producing plant, and will make immediate extensions and improvements, including the installation of additional equipment. H. L. Sullivan and E. B. Houston are heads.

PICHER—The Skelton Lead & Zinc Co. has preliminary plans under advisement for the rebuilding of the portion of its plant, recently destroyed by fire, with loss of about $175,000, including equipment. The bulk of the damage was sustained at the No. 5 mill.

Oregon

PORTLAND—The Electric Steel Foundry Co., York and 24th Sts., plans the early installation of electric furnaces and other equipment at its new 1-story foundry, 50x159 ft., now in course of construction.

Pennsylvania

PHILADELPHIA—Thomas M. Royal & Co., Bryn Mawr, Philadelphia, manufacturers of paper products, have purchased property at 7th and Grange Sts., Olney district, 290x530 ft., previously used by the Fox Motor Car Co., for a consideration said to be $285,000. The new owner plans to remodel and improve the plant for a new paper mill, and will occupy at an early date.

CONNELLSVILLE—The Capstan Glass Co., manufacturer of tumblers and other table glassware, is reported to have preliminary plans under advisement for enlargements in its plant, to consist of a new unit, with equipment for considerable increase in output.

PALMERTON—The New Jersey Zinc Co. has asked bids for structural steel framework for a new building at its local plant, to be equipped primarily as a rolling mill for the production of zinc sheets, plain and corrugated. It will cost more than $90,000.

South Carolina

SPARTANBURG—The Gulf Refining Co., Frick Bldg., Pittsburgh, Pa., is perfecting plans for the construction of a new oil storage and distributing plant on Union St., to cost close to $100,000, including equipment.

Tennessee

NASHVILLE—The Nashville Pottery Co., operating a plant at McKenzie, Tenn., plans for the early removal of the pottery to site at Nashville, where considerable increase will be made in facilities, including additional equipment. C. Sparks is head.

Texas

HOUSTON—The Texas Chemical Co., Scanlon Bldg., is said to have preliminary plans in progress for the construction of a new plant on site selected on the ship channel, to be used primarily for the manufacture of commercial fertilizers. It is estimated to cost in excess of $170,000, with equipment. S. Pulser is president.

DALLAS—The Gas & By-Products Co., operating the Dallas Gas Co., United States Carbon Co. and other interests, is perfecting plans for the early sale of a bond issue of $3,000,000, a portion of the proceeds to be used for extensions and improvements. H. C. Morris is vice-president.

DALLAS—The American Sulphur & Fertilizer Co. is arranging plans for the construction of a new plant in the Love Field section, to consist of a sulphur refinery, estimated to cost $100,000, with equipment; sulphuric acid plant to cost approximately $80,000; and 1-story fertilizer works. The company will develop an initial combined output of about 300 tons per day. Raw materials properties totaling about 80 acres in Culberson County will be taken over, and equipment for production installed. Permission has been secured to dispose of a stock issue of $328,250, the proceeds to be used in connection with the plant project. W. M. Harris is president and O. M. Caskey, secretary.

SHREVEPORT — The Fortuna Oil Co., Shreveport, is planning for the erection of a gas pumping plant in the vicinity of Bethany, Tex., estimated to cost $200,000, with equipment. A storage and distributing plant will also be built on the Mansfield Rd., Shreveport, to cost about $100,000.

Virginia

ROANOKE—The Roanoke Concrete Pipe Co., recently organized with a capital of $250,000, plans for the operation of a local plant for the manufacture of reinforced-concrete pipe and kindred products. G. D. Shiplett, Roanoke, is president.

ROANOKE—The Roanoke Gas Light Co. plans for extensions and improvements in its artificial gas works in the North East section, including a new retort building, by-products plant and installation of equipment, estimated to cost $60,000. W. J. McCorkindale is manager.

Wisconsin

MILWAUKEE — The Standard Sanitary Mfg. Co., Bessemer Bldg., Pittsburgh, Pa., manufacturer of enameled iron sanitary ware, has awarded a general contract to W. W. Oeflein, Inc., 86 Michigan St., Milwaukee, for the erection of a 5-story and basement addition to its local plant, 70x175 ft., to cost $250,000, with equipment. The Hunting-Davis Co., Century Bldg., Pittsburgh, is architect.

New Companies

BARTLING & HUSSEY INDEPENDENT OIL CO., INC., 213 South Jefferson St., Litchfield, Ill.; oils, greases, etc.; $25,000. Incorporators: L. A. Hussey, H. G. Hedgcock and C. F. Bartling.

AMARILLO REFINING CO., Amarillo, Tex.; refined petroleum products; $400,000. Incorporators: Reece S. Allen, Gordon West and C. J. Ferguson, all of Amarillo.

MAPOLROW CO., Poughkeepsie, N. Y.; flavoring extracts and kindred products; $100,000. Incorporators: N. Deyo, S. Pollack and W. J. Ward. Representative, E. C. O'Connell, Poughkeepsie, attorney.

INDIANAPOLIS ELECTRIC STEEL CASTING CO., INC., Indianapolis, Ind.; steel and other metal castings; 500 shares of stock, no par value. Incorporators: Robert and Herman Lifchitz, both of Indianapolis.

PORTER MIRROR CO., Los Angeles, Calif.; mirrors and other glass products; $150,000. Arrangements are being perfected for the immediate erection of a local plant. Incorporators: Enos Porter, S. M. Haskins and Homer D. Crott. Representative: Gibson, Dunn, Crutcher, 111 Merchants National Bank Bldg., Los Angeles, attorney.

FOLO LABORATORIES, INC., 137-43 West 62nd St., Chicago, Ill.; chemicals and chemical byproducts; $25,000. Incorporators: W. F. Straub, J. B. Creevy and Prentiss McKenzie.

OAK CITY GUANO CO., Bartow, Fla.; fertilizer products; $50,000. Incorporators: James F. MacEnroe and W. G. Wright, both of Bartow.

BETTER PAINT & VARNISH CO., Boston, Mass.; paints, varnishes, oils, etc.; $20,000. Ferdinand Ruth is president, and Eli Siegel, 10 Abbott St., Dorchester, Mass., treasurer.

W. F. SMITH PAINT SUPPLY CO., St. Petersburg, Fla.; paints, varnishes, oils, etc.; $30,000. W. F. Smith is president, and Frank E. Ridgeway, secretary, both of St. Petersburg.

CLAYTON MARK & CO., INC., 111 West Washington St., Chicago, Ill.; steel, manganese, copper, zinc and kindred products; $1,500,000. Incorporators: Clayton and Anson Mark, and Leland K. Neeves.

JAMESTOWN BLOCK & TILE CO., Jamestown, N. Y.; cement blocks, tile and similar products; $50,000. Incorporators: B. A. McClure and N. B. C. Stiteler. Representative: R. M. Bates, Jamestown, attorney.

WARREN PETROLEUM CO., St. Joseph, Mo.; petroleum products; $50,000. Incorporators: Lewis A. Warren, Charles N. Atkinson and John F. Moyles, all of St. Joseph.

WELLSTON CLAY PRODUCTS CO., Wellston, O.; tile and kindred burned clay specialties; $50,000. Incorporators: Edward T. Evans and John T. Ogier, both of Wellston.

PIVOT CITY PRINTING INK CO., Indianapolis, Ind.; printing and other inks; 1,000 shares of stock, no par value. Incorporators: Edwin A. Hunt, John D. Kennedy and John F. Grady, all of Indianapolis.

HYDROIL PROCESS CORP., care of the United States Corporation Co., Dover, Del., representative; petroleum and byproducts; $11,500,000.

UNITED STATES TILE CO., Brooklyn, N. Y.; ceramic tile products, etc.; nominal capital $5,000. Incorporators: A. Galfano and V. Aguece. Representative: M. F. Longo, 350 Fulton St., Brooklyn.

HAWKEYE ZINC CO., Miami, Okla.; operate zinc properties for commercial production, with plans for early installation of plant; $200,000. Incorporators: A. O. Wallace, Miami; M. G. West and T. M. Barham, Kansas City, Mo.

STRAUB BLOCK CO., New Kensington, Pa.; cement tile, blocks and kindred products; $50,000. Frank S. Moran, New Kensington, is treasurer.

GOLDELINE OIL CORP., Oklahoma City, Okla.; refined petroleum products; $500,000. Incorporators: B. F. Keene, J. P. Umpleby and Hugh McKinnie, 1803 North Western St., Oklahoma City.

VARICK CO., New York, N. Y.; chemicals and chemical byproducts; $50,000. Incorporators: O. A. Ernst, H. Lehrich and H. E. Herman. Representative: Herman & Ernst, 170 Broadway, New York.

SANITARY PAPER PRODUCTS CORP., Pittsburgh, Pa.; paper goods; $100,000. John Michael, 114 Greenfield St., Pittsburgh, is treasurer and representative.

E. MORRIS MFG. CO., Detroit, Mich.; leather goods; $18,000. Incorporators: Harold G. Mehrer and Morris Udkovich, 523 Kirby St., Detroit.

RADICAL RUBBER CO., New York, N. Y.; rubber specialties; $10,000. Incorporators: S. M. Newman and B. Weinberg. Representative: S. E. Levene, 55 John St., New York.

MOTORKOOL GASOLINE CORP., Brooklyn, N. Y., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative; operate gasoline refineries; $3,500,000. Incorporators: H. G. Knowles, Geoffrey Minnis and C. D. Sinclair.

FLYNN-WOLFF BRONZE FOUNDRY, INC., Swissvale, Pa.; bronze and brass castings; $15,000. E. A. Wolff, 7717 Lyman St., Pittsburgh, is treasurer.

FINUCANE & MACFIE, INC., New York, N. Y.; copper products; $20,000. Incorporators: D. Finucane, C. A. Macfie and M. C. Gifford. Representative: V. F. Follmar, 49 Chambers St., New York.

Industrial Notes

The Chicago Pneumatic Tool Co. has moved its Los Angeles office and service department to 655 Sante Fe Avenue.

The Swenson Evaporator Co. (a subsidiary of the Whiting Corporation), Harvey, Ill., has opened a sales office at 316 Jackson Bldg., Buffalo, N. Y., to handle the sale of its complete line of evaporators, continuous crystallizers, pulp mill machinery, beet-sugar equipment, etc. This office will be operated in conjunction with Messrs. George G. Crewson and Arthur E. Smith, of the Industrial Equipment Co.